PRELIMINARY FUNCTIONAL SERVICING & STORMWATER MANAGEMENT REPORT

8079 EIGHTH LINE

TOWN OF HALTON HILLS
REGION OF HALTON

PREPARED FOR:

GILBACH (HALTON HILLS) INC.

PREPARED BY:

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2800 HIGH POINT DRIVE, SUITE 100
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CROZIER
CONSULTING ENGINEERS

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1.0 Introduction

C.F. Crozier & Associates Inc. (Crozier) was retained by Gilbach (Halton Hills) Inc. (the Owner) to prepare a Functional Servicing Report in support of an Official Plan Amendment (OPA) application for the property located at the northeast corner of Eighth Line North and Steeles Avenue (Site), in the Town of Halton Hills known as 8079 Eighth Line. This report demonstrates how the proposed development's functional servicing will conform with the requirements of the Town of Halton Hills (Town), Region of Halton (Region), Conservation Halton (CH), Ministry of Transportation (MTO), and the recommendations of the Scoped SWS.

This report has been prepared to document the functional level servicing strategy for the proposed development, in order to confirm that the site can be supported by the Town and Region local infrastructure. As noted in the pre-consultation meeting with the local review agencies on June 10, 2021, a Comprehensive Servicing Study will be required to fulfill conditions of the ROPA 47 Settlement for the site.

Further to recent discussions with the Region, a Terms of Reference was prepared to complete a "Scoped Area Servicing Plan" for the site, in order to demonstrate conformance with the Premier Gateway Employment Area (PGEA) Phase 1B Area Servicing Plan. The Scoped Area Servicing Plan for the site will include review and assessment of the Region's existing and future local infrastructure to confirm the impact of the proposed development upon the Region's water and wastewater network. The "Scoped Area Servicing Plan" shall be provided in a subsequent submission, under separate cover, subject to the Terms of Reference and subsequent Review Comments provided by the Region dated February 11, 2022.

2.0 Background

2.1 Existing Conditions

The Site encompasses an area of approximately 19.06 ha with a proposed development area of approximately 7.79 ha and currently consists of natural heritage and agricultural land. According to the Town's Official Plan, the Site lies within an agricultural area. The site is bound by Eighth Line and seven (7) residential properties fronting Eighth Line to the west, one (1) residential property fronting Eighth Line and agricultural lands to the north and east, and Steeles Avenue and a cemetery to the south.

The East Sixteen Mile Creek traverses the northeastern portion of the property and is regulated by Conservation Halton. The Site is located within the Sixteen Mile Creek watershed.

The Subject Site was brought into the Premier Gateway Phase 1B Employment Area Secondary Plan subject to the Regional Official Plan Amendment 47 Settlement (see Appendix A for details).

2.2 Proposed Conditions

The proposed development of approximately 7.79 ha envisions the development of four development blocks across the site area. The main development block (Development Block 4 – 5.57 ha) fronts Eighth Line and currently includes an integrated recreational/entertainment development consisting of a water park, 8-storey hotel, conference centre, and ancillary uses, in addition to supporting at-grade parking and a standalone restaurant building. In the northeast corner of the site, a second development block (Development Block 1 – 1.64 ha) is proposed which consists of a Spa facility and a Flying Theatre with supporting at-grade parking. Two additional development

blocks (Development Block 2 – 0.09 ha) and (Development Block 3 – 0.49 ha) are also contemplated.

Site access for Block 1 and Block 4 is provided from Eighth Line, with bus access proposed from Eighth Line. A 10 m wide driveway crossing of a tributary of Sixteen Mile Creek connects Block 4 to Block 1. Refer to the Concept Plan prepared by Corbett Land Strategies Inc. (March, 2022) for details provided in Appendix A. The proposed development blocks and corresponding development limits are further to the conclusions and recommendations as provided in the Scoped SWS (February 2022). Refer to the Scoped SWS for further details.

Note, this report focuses on the functional servicing and preliminary stormwater management design to support development of Block 1 and Block 4. Development Block 2 and 3 shall be further assessed in a future study at a later date.

2.3 Related Studies & Reports

This report has been completed in accordance with the guidelines, standards and policies of the Town of Halton Hills, Halton Region and Conservation Halton. The relevant background studies and reports include:

- Scoped Subwatershed Study Northeast Corner Steeles Avenue and 8th Line – Final Report (Second Submission) prepared by Jennifer Lawrence and Associates Inc., dated February 2022
- Halton Region Official Plan (Interim Office Consolidation - November 10, 2021)
- Conservation Halton Guidelines for Stormwater Management Engineering Submissions (May 2021)
- Halton Region Linear Design Manual (October 2019)
- Water Supply for Public Fire Protection, Fire Underwriters Survey (1999)
- MECP Guideline for Water System Design (2008)
- MECP Guideline for Wastewater System Design (2008)
- Halton Region's 2022 Development Charges Update Water/Wastewater Technical Report, September 2021
- Urban Services Guidelines - Regional Official Plan Guidelines
- Town of Halton Hills Stormwater Management Policy (March 2009)
- Stormwater Management Planning and Design Manual (MECP, March 2003)

3.0 Water Servicing

The Region is responsible for the operation and maintenance of the public water and treatment system in the Town and any private water service will connect to this public water supply system. The following section of the report analyses the existing and proposed domestic and fire water servicing conditions for the Site.

3.1 Existing Water Servicing

A review of the As-Constructed Drawings along Steeles Avenue and Eighth Line dated January 2014 (AECOM, H-01315), received from Halton Region indicate the following water infrastructure exists in the proximity of the subject property:

- A 600 mm dia. CPP feedermain along Steeles Avenue
- A 300 mm dia. PVC watermain which terminates at a fire hydrant approximately 50m north of the Eighth Line and Steeles Avenue intersection.

It is understood that there was previously a residential building on site which was serviced by a private well, and as such there are no existing connections to the Region's water supply system. Upon development, if required, the existing private well shall be decommissioned and a connection shall be made to the Region's water infrastructure. Refer to Section 3.2 and Section 3.3 for further details.

3.2 Water Design Demand

3.2.1 Domestic Water Demand

The Water and Wastewater Linear Design Manual (Halton Region, 2019) was used to estimate the proposed water demands for industrial purposes.

The results are summarized below in Table 2, with detailed calculations provided in Appendix B.

Table 2: Proposed Water Demand

Development Block	Development Area (ha)	Estimated Population	Average Daily Demand (L/s)	Maximum Daily Demand (L/s)	Peak Hour Demand (L/s)
Block 1 (Spa/Flying Theatre)	0.49	148	0.47	1.07	1.07
Block 4 (Waterpark/Hotel)	5.57	502	1.60	3.59	3.59
TOTAL	**6.06**	**650**	**2.07**	**4.66**	**4.66**

Note: An average daily demand of 0.275 m^3/cap/day was used, along with a maximum day factor of 2.25 and a peak hour factor of 2.25 per the Water and Wastewater Linear Design Manual (Halton Region, 2019). A population density of 90 persons/ha is applied based on a "Light Commercial" land use.

As shown in Table 2, it is proposed that the development will have a peak hourly water demand of 4.66 L/s.

3.2.2 Fire Protection Water Demand

The Fire Underwriters Survey (FUS) method was used to determine the fire flow demands for the proposed development. Flow requirements were calculated based on the building Gross Floor Area (GFA) from the Concept Plan prepared by Corbett Land Strategies Inc., received in January 2022.

The results are summarized in Table 3, with detailed calculations provided in Appendix B. As Architectural drawings are not yet available, reasonable assumptions were made regarding the Construction Type, Occupancy Hazard, and Fire Suppression System for the various buildings.

Table 3: Proposed Fire Flow Demands

Development Block	Building Use	Fire Design Area (sqm)	Fire Flow (L/s)	Duration (hrs)
1	Spa	1,186	83.3	1.75
1	Flying Theatre	3,000	100.0	2.00
4	Restaurant	464	66.7	1.50
4	Hotel	5,553	166.7	2.00
4	Waterpark	7,599	200.0	2.50
4	Ancillary Areas	7,449	183.3	2.25

The site fire line shall be sized to accommodate the highest fire flow demand according to the FUS calculations. Therefore, the site shall be designed for a peak fire flow demand of 200.0 L/s for a duration of 2.50 hours.

A hydrant flow test will be completed in Spring 2022 (when weather permits), to evaluate the existing Regional watermain pressures and flows available to service the site to meet the fire flow demand requirement.

It should be noted that the fire flows determined from the FUS method is a conservative estimate for comparison purposes only. The Mechanical Engineer for the development will complete the required analysis for fire protection and the Architect will design fire separation methods per the determined fire flow rate to meet municipally available flows and pressures. The fire system design will be done at the Site Plan Approval or building permit stage of the project.

3.3 Halton Region Water Servicing Plan – PGEA Phase 1B Area Servicing Plan

According to the Area Servicing Plan (GM BluePlan, 2019), after commissioning of the Region's proposed Ultimate Pressure Zone Realignment, the Site will be serviced as part of the new Zone 250. The ultimate pressure zone build out is expected to be completed beyond 2021.

Based on the Halton Region Capital Works mapping, twin 900 mm dia. watermains were recently constructed on Trafalgar Road from Britannia Road to the new Zone 4 Reservoir. Based on the current pressure zone alignment, the Trafalgar Road watermain has no connection to the existing 600 mm dia. watermain on Steeles Avenue. This watermain is part of the Region's ultimate pressure zone build out (Zone 250).

According to the Area Servicing Plan (GM BluePlan, 2019), a 300 mm dia. local watermain is proposed to continue north on Eighth Line from the existing fire hydrant. The proposed extension is expected to be completed by developer funded improvements within the 2021- 2031 planning horizon in support of the PGEA Phase 1B lands. A 300 mm dia. local watermain is also anticipated to be constructed along the future Proposed Collector 3, with the 300 mm dia. watermain extending south on Trafalgar Road, connecting back to the existing 600 mm dia. watermain on Steeles Avenue. This report also suggests that the Region's water distribution system has sufficient capacity to support the development of the Premier Gateway Secondary Plan lands, with connections at the boundary of the Site. Confirmation that the site can be supported by the future watermain infrastructure will be provided through the Scoped Area Servicing Plan to be submitted in a subsequent submission, under separate cover.

3.4 Proposed Water Servicing

To provide water servicing to the proposed development, connections to the municipal watermain are required. As discussed in Section 3.1, there is an existing 600 mm dia. watermain located along Steeles Avenue, and a 300 mm dia. watermain is terminating on Eighth Line approximately 50 m north of the Eighth Line and Steeles Avenue Intersection.

A 300 mm dia. watermain extension is anticipated starting from the existing 300 mm dia. watermain on Eighth Line, running north and looping back to Steeles Avenue subject to development of the PGEA Phase 1B lands. The proposed local watermain extension would operate within Pressure Zone M5L until the Region completes its conversion to Pressure Zone 250. It should be noted that water services accounting for the residential population north of the proposed development will be determined through consultation with the Region at the detailed design stage. Details regarding the design and construction of the proposed 300 mm diameter watermain extension shall be provided under a separate design package.

The site is proposed to be serviced by the future 300mm diameter watermain on Eighth Line with a 200mm diameter looped internal water service connection. The 200mm diameter water service shall connect to Eighth Line at the primary site access (adjacent to the conference centre) and at the secondary site access (adjacent to the restaurant). The water service connection shall be equipped with property line valves in box further to Region standards.

Development Block 1 – Flying Theatre and Spa

Development Block 1 shall be serviced by an extension of the internal 200mm diameter water service connecting to the main internal loop within Block 4. Individual water service connections from the Flying Theatre and the Spa will connect to the 200mm diameter water service connection with final domestic service sizes and fire line per detailed design. The 200mm diameter water service will cross the NHS area and as such, it is anticipated that a trenchless construction methodology will be required. The final details and specifications for the water service shall be addressed through the future detailed design.

Development Block 4 – Restaurant, Hotel, Waterpark, and Ancillary Buildings

Development Block 4 shall be serviced by the internal 200mm diameter water service loop. Individual domestic and fire line water service connections shall be made to the Restaurant from the 200mm diameter loop. Likewise, individual domestic (150mm diameter) and fire line (200mm diameter) water service connections shall be made from the 200mm diameter water service to jointly service the hotel, waterpark, and ancillary buildings. The final details and specifications for the water service connections shall be addressed through the future detailed design.

Refer to Drawing C102 – Preliminary Servicing Plan for details.

4.0 Sanitary Servicing

The Region is responsible for the operation and maintenance of the public sanitary sewage collection system in the Town, and any private sanitary service will connect to this public sewage collection system. The existing and proposed sanitary servicing is discussed in the following sections.

4.1 Existing Sanitary Servicing

According to the Region's As-Constructed Drawings (H-01135, H-01313, H-01314, H-01315), there is an existing 200 mm dia. sanitary sewer starting at the Trafalgar Road and Steeles Avenue Intersection. The sanitary sewer flows east on Steeles Avenue and increases in diameter to a 250 mm dia. pipe, and ultimately to a 300 mm dia. pipe at the Eighth Line and Steeles Avenue intersection. This sanitary infrastructure drains to an existing sewage pumping station HH#3 Wastewater Pumping Station (WWPS) located east of the Eighth Line and Steeles Avenue intersection. Currently, there are no existing sanitary sewers along Eighth Line.

It is understood that there was an existing residential building on site that was supported by a private septic/sewage system, and as such there are no existing connections to the Region's wastewater collection system. Upon development, if required, the private septic system shall be decommissioned, and a connection shall be made to the Region's wastewater infrastructure. Refer to Section 4.2 and Section 4.3 for further details.

4.2 Sanitary Design Flow

The Water and Wastewater Linear Design Manual (Halton Region, 2019) was used to estimate the proposed sanitary design flows for the Site.

A summary of the results is presented in Table 4 and detailed calculations are provided in Appendix C.

Table 4: Proposed Sanitary Design Flows

Development Block	**Development Area** (ha)	**Average Daily Flow** (L/s)	**Peaking Factor**	**Peak Flow** (L/s)	**Infiltration Flow** (L/s)	**Total Proposed Sanitary Flow** (L/s)
Block 1 (Spa/Flying Theatre)	0.49	0.47	3.35	1.58	0.47	2.04
Block 4 (Waterpark/Hotel)	5.57	1.60	3.18	5.07	1.59	6.67
TOTAL	**6.06**	**2.07**	**-**	**6.65**	**2.06**	**8.71**

Note: An average daily sanitary flow of 24.75m^3/ha/day was used, along with an infiltration flow of 0.000286 m^3/ha/s per the Water and Wastewater Linear Design Manual (Halton Region, 2019). A population density of 90 persons/ha is applied based on a "Light Commercial" land use.

As shown in Table 4, it is proposed that the development will have a total sanitary demand of 8.71 L/s.

4.3 Halton Region Wastewater Servicing Plan – PGEA Phase 1B Area Servicing Plan

According to the 90% Design Plan and Profile Drawings from the Request for Pre-Qualification document (Halton Region, 2020), a 1200 mm dia. trunk sewer extension is proposed to extend north along Eighth Line to the proposed 1200 mm dia. trunk sewer on Steeles Avenue, ultimately flowing south. The Area Servicing Plan (GM BluePlan, 2019) states that the existing HH#3 WWPS will be decommissioned upon the completion of the proposed trunk sewer which will accept all existing local sanitary flows, to be conveyed further south to the Mid-Halton Wastewater Treatment Plant. In addition to the trunk sewer, a 300 mm dia. local sanitary sewer is anticipated to be installed along Eighth Line, with a completion date anticipated prior to 2031 build out. Confirmation that the site

can be supported by the future wastewater infrastructure will be provided through the Scoped Area Servicing Plan to be submitted in a subsequent submission, under separate cover.

4.4 Proposed Sanitary Servicing

To provide sanitary servicing to the proposed development, connections to the municipal sanitary sewer network are required. In lieu of connections to the existing sanitary infrastructure on Eighth Line, the proposed development is anticipated to connect to the future 1200mm diameter trunk sewer on Eighth Line. Subject to the Scoped Area Servicing Plan, confirmation will be provided that the site can connect to the trunk sewer without any negative impacts to the Region's downstream wastewater system.

The site is proposed to be serviced by a 250mm diameter sanitary internal sanitary sewer network with a connection at a node to the future 1200mm diameter trunk sanitary sewer on Eighth Line. The sanitary service connection shall be equipped with property line control manhole further to Region standards.

Development Block 1 – Flying Theatre and Spa

Development Block 1 shall be serviced by an extension of the internal 250mm diameter sanitary service connecting to the main internal sanitary sewer network within Block 4. Individual sanitary service connections from the Flying Theatre and the Spa will connect to the 250mm diameter sanitary service, with final service sizes per detailed design. In order to cross the NHS area, it is anticipated that a sanitary lift station will be required. Construction of the proposed sanitary sewer is anticipated to employ trenchless construction methodology and sanitary forecemain to ensure no disturbance to the NHS. The final details and specifications for the sanitary service and lift station shall be addressed through the future detailed design.

Development Block 4 – Restaurant, Hotel, Waterpark, and Ancillary Buildings

Development Block 4 shall be serviced by the internal 250mm diameter sanitary sewer system. An individual sanitary service connection shall be made from the Restaurant to the 250mm diameter sanitary sewer system. Likewise, an individual sanitary service connections shall be made to the 250mm diameter water service to jointly service the hotel, waterpark, and ancillary buildings. The final details and specifications for the sanitary service connections shall be addressed through the future detailed design.

Refer to Drawing C102 – Preliminary Servicing Plan for details.

5.0 Drainage Conditions

5.1 Pre-Development Drainage Conditions

A portion of the Site is within an area regulated by Conservation Halton (CH) pursuant to O. Regulation 162/06. The East Branch of the Sixteen Mile Creek (referred to as ESMC1 in the Scoped SWS) and a tributary (referred to as TESMC1 in the Scoped SWS) are located on the Site. The extent of CH's regulated area has been refined through the Scoped SWS process and includes both watercourses, associated erosion and flooding hazards (plus 15 m) and associated riparian wetlands (plus 30 m).

The subject property does not currently have stormwater management controls. According to the topographic survey by Dolliver Surveying Inc. completed on June 7, 2019, the site generally slopes towards ESMC1 located within the property, which conveys flows southwards towards Steeles

Avenue. The subject property has been delineated as one catchment consisting of a total area of 19.06 ha and is assigned a runoff coefficient of 0.25 to represent the agricultural land and natural area on the property (Catchment 101).

In addition to drainage within the property, there is a 1.53 ha external area (Catchment EXT1) that also drains through the Site. Drainage from this area flows eastwards towards TESMC1 within the Site, which conveys flows east to ESMC1 within the property. The external catchment consists of seven (7) residential properties, all of which are occupied by single detached homes, and is assigned a runoff coefficient of 0.45. There is also a large upstream external catchment area north of 8079 Eighth Line (approximately 60 ha). Refer to the Scoped SWS for details regarding external drainage areas conveyed through the Site.

Refer to the Pre-Development Drainage Plan (Figure 1) for further information on the existing drainage conditions.

5.2 Post-Development Drainage Conditions

Based on the Concept Plan prepared by Corbett Land Strategies Inc., the proposed development consists of a variety of uses including a hotel, a waterpark, a restaurant, a spa and a theatre, with site access provided through Eighth Line. The Site will be graded to promote positive drainage away from the buildings and to convey stormwater towards a system of catchbasins that will be used to capture runoff to allow for treatment prior to being released to ESMC1, mimicking existing conditions. The external area will continue to be conveyed through the site, with its ultimate outlet to TESMC1 maintained, following development of the Site. Table 5 summarizes the post-development drainage areas as shown in Figure 2.

Table 5: Post-Development Areas and Runoff Coefficients

Catchment No.	Land Use	Outlet Location	Total Area (ha)	Runoff Coefficient (RC)
200	Commercial	ESMC1	5.25	0.90
201	Commercial	TESMC1	1.55	0.90
202	Natural Area	TESMC1	2.76	0.25
204	Natural Area	ESMC1	9.50	0.25
Total Site	**-**	**-**	**19.06**	**-**
EXT1	Residential	TESMC1	1.53	0.40

6.0 Stormwater Management

The stormwater management design criteria for the site were established using the Town of Halton Hills Stormwater Management Policy (March 2009), Conservation Halton Guidelines for Stormwater Management Engineering Submissions (May 2021) and the Scoped Subwatershed Study Northeast Corner Steeles Avenue and 8th Line – Final Report (Second Submission) (Jennifer Lawrence and Associates Inc., February 2022), referred to as the Scoped SWS in this report. The stormwater management criteria are summarized in the following pages.

Water Quantity Control

According to the Town of Halton Hills Stormwater Management Policy (March 2009), the minimum control is to maintain post-development peak flow at pre-development levels for all events up to the 100-year or Regional storm levels, or as otherwise determined through consultation with CH. Given that the property is located within the Sixteen Mile Creek Watershed, the Site is within CH jurisdiction and therefore, stormwater quantity control is governed by the conservation authority.

Per the Conservation Halton Guidelines for Stormwater Management Engineering Submissions (May 2021), stormwater quantity control requirements are typically established through a Scoped SWS. The Scoped SWS includes unitary discharge and volume requirements for the subject property based on the proposed future land use to ensure post-development peak flows to the receiving Creek do not exceed their pre-development levels at all key locations within the subject property and further downstream. Table 6 summarizes the unit flow rate for the Site.

Table 6: Summary of Unit Flow and Volume Determined per Scoped SWS for the Site

Storm Event	**Unitary Discharge** ($m^3/s/ha$)	**Cumulative Unitary Volume** (m^3/impervious area)
Erosion (25 mm Event)	0.0021	124
25-Year	0.0049	625
100-Year	0.0056	824
Regional	0.0273	1,703

The Scoped SWS has assumed Regional Storm controls are required. The Regulatory Storm is the greater of the uncontrolled 100-year and Regional (Hurricane Hazel) flows. The Scoped SWS confirmed that the largest storm event for the subject property is the Regional Storm. It is noted that CH does not support flooding of internal roadways within additional storage areas.

Stormwater quantity control is only required for the Site. The external catchment flowing through the Site under existing conditions is not required to be controlled and will therefore only be conveyed through the property following development. All external drainage will be conveyed through overland flow on a portion of the property that is to remain undeveloped.

Water Quality Control

Both CH and the Scoped SWS indicate that an Enhanced level of water quality protection (80% total suspended solids (TSS) removal) is required for the Site. CH also notes that this criterion represents a minimum requirement that may be superseded by the results of additional studies or municipal or provincial requirements. According to Town standards, quality controls are to be implemented based on the approved Subwatershed or Master Drainage Plans. Therefore, the water quality control target set for the Site is as recommended in the Scoped SWS.

Given that fish habitat was identified on Site, thermal mitigation must also be considered. The Scoped SWS noted that thermal mitigation will be required within the study area to reduce the impacts to on-site and downstream fisheries. Thermal mitigation is also a requirement of CH when stormwater is directed to sensitive features where fish habitat is present. A target of 24°C is recommended in the Scoped SWS.

Phosphorus loading is another water quality concern listed by CH however, they indicated that the need for phosphorus reductions should be assessed in a subwatershed study. The Scoped SWS does not indicate that phosphorus reduction is required for the subject property.

Water Balance

According to CH guidelines, water balance requirements should consider both a site scale and a feature-based scale, with the objective to:

- Replicate as closely as possible existing hydrologic conditions by maintaining a balance between infiltration, runoff and evapotranspiration;
- Maintain as closely as possible groundwater and base flow regimes; and

- Ensure long-term sustainability of hydrological/ecological form and function of natural feature.

As part of the Scoped SWS, both a site-specific water balance and feature-based water balance for the wetland on site was completed. Refer to Section 6.3 for details and proposed mitigation measures to address water balance requirements.

Erosion Control

An erosion threshold assessment is typically required by CH to determine the sensitivity of watercourses to establish the erosion control criteria for a Site. An erosion analysis was completed by GEO Morphix as part of the Scoped SWS and determined that based on the proposed stormwater management strategies on site, the receiving watercourse should be near-equivalent geomorphic state to existing conditions, with no expected increases in erosion or sedimentation based on the proposed stormwater management design. Therefore, no further erosion control is required in addition to the water quantity control measures proposed on site.

The following sections will describe how the stormwater management for the subject property adheres to the above guidelines.

6.1 Stormwater Quantity Control

The stormwater quantity control measures shall be designed to control post-development peak runoff from the development to the unitary flow rates established by MGM listed in Table 6. The developable area on site was divided into two catchments, each with their own outlet to the watercourse within the subject property. The storage requirements for each catchment have been determined using the cumulative unitary volumes provided by MGM. To determine the volume requirements, it was conservatively assumed that the catchments will be made at the detailed design stage to minimize imperviousness wherever possible. Refer to Table 7 for the storage requirement for each catchment.

Table 7: Summary of Volume Requirements

Storm Event	**Cumulative Unitary Volume** (m^3/impervious area)	**Volume Required** (m^3)	
		Catchment 200	**Catchment 201**
Erosion (25 mm Event)	124	651	192
25-Year	625	3,281	969
100-Year	824	4,331	1,277
Regional	1,703	8,941	2,640

Catchment 200 consists of the majority of the developable area (Block 4), including the main building and a large parking lot. Runoff from this catchment will be captured through a system of catchbasins and conveyed to an underground stormwater cistern, providing 4,331 m^3 of storage, located in the southeast corner of the parking lot. Catchment 200 will outlet to the ESMC1 through a headwall located just east of Building 1. The volume required in excess of the 100-year storm event will be provided through surface storage within the parking areas.

Catchment 201 consists of buildings and a parking lot. Similar to Catchment 200, runoff from this catchment will be captured through a system of catchbasins and conveyed to an underground stormwater cistern. The cistern is proposed below the parking stalls just east of Building 3 and will provide a total storage volume of 1,277m^3. Stormwater from the cistern will then be conveyed south and discharge to ESMC1 according to the Scoped SWS through a proposed headwall. The volume

required in excess of the 100-year storm event will be provided through surface storage within the parking areas.

Refer to Drawing C102 for the location of the proposed storm sewers, catchbasins, headwalls, and stormwater cisterns.

6.2 Stormwater Quality Control

Stormwater quality control is dictated by the Town of Halton Hills which states that the proposed development must achieve 80% total suspended solids (TSS) removal on an annual loading basis for 90% of runoff leaving the site.

Water quality for Catchments 200 and 201 is achieved through the implementation of an off-line weir diversion Jellyfish Filter to be installed downstream of both storage chambers. Jellyfish Filter Model JF10-15-4 and JF8-9-2 (or approved equivalent) for Catchments 200 and 201, respectively, will provide the enhanced level of protection for the site with a TSS removal efficiency of 89%. Due to the large impervious area of Catchment 200, two JF10-15-4 units in parallel with upstream flow-splitting in the diversion MH are required. Appendix C contains the Jellyfish Filter sizing calculations prepared by the manufacturer.

In addition to TSS removal, thermal mitigation is also a requirement for this Site. The use of underground cisterns and bioswales are considered viable methods for achieving thermal mitigation on Site as recommended in the Scoped SWS. Stormwater cisterns are proposed on Site to provide water quantity control. Implementation of bioswales within the property will be explored further at the detailed design stage to improve thermal mitigation as needed.

6.3 Water Balance

A water balance study was completed as part of the Scoped SWS to predict changes in hydrologic conditions on Site following development and to assess potential risks to the tributary and wetlands along the north and east boundaries of the Site. Through investigation of the wetlands on the property, it was determined that Wetland 1, located just west of the proposed road connecting Catchments 200 and 201, and Wetland 5/6, located within the southeast section of the developable area, experience an infiltration and runoff deficit. A feature-based water balance is therefore required to maintain the hydrologic function of these feature. To minimize the feature-based impact, LIDs are recommended to mitigate potential impacts to the wetlands including capture, storage and infiltration of rooftop runoff.

For Wetland 1, only a small portion of the existing wetland is proposed for development (1% reduction). Mitigation for the wetland includes directing roof drainage to an infiltration facility located upgradient of Wetland 1. The Scoped SWS indicates that additional clean roof drainage from the Flying Theatre can also be directly sent to the wetland area if required but that this need will be determined at the detailed design stage.

For Wetland 5/6, the catchment includes the majority of the proposed development (95% reduction). Mitigation for the wetland includes directing roof drainage from the proposed complex to an infiltration facility located upgradient of Wetland 5/6, with overflow from the facility directed to the wetland to maintain runoff contributions. According to the Scoped SWS, the 5 mm rain event from the roof area was deemed sufficient to provide water balance for the wetland.

It is noted that a total of 0.36 ha of wetland is proposed for removal as part of the development. Wetland compensation is proposed in the northwest corner of the Site at a slightly greater than 1:1 ratio, with a total of 0.4 ha of wetland habitat provided to mitigate the proposed removal. A 450

mm diameter clean water collector pipe is proposed to convey clean rooftop water from the complex to the compensation wetlands in the northwest corner of the Site.

As a result of development, there will also be an increase in evaporation and runoff with reduced infiltration within the developable area. These changes are mainly due to the increase in impervious area on Site. To minimize the site-specific impact, the Scoped SWS recommends that Low Impact Development (LID) be implemented to mitigate the Site's infiltration deficit including capture, storage and infiltration of stormwater from the impervious surfaces. Open bottom infiltration chambers are proposed within the parking lots of Block 1 and 4 to address the site-specific infiltration deficit.

Potential for LID implementation on Site to achieve the site-specific and feature-based water balance requirements will be explored further at the detailed design stage. Refer to Drawing C102 for the location and sizing of preliminary LIDs and storm sewers to satisfy site water balance requirements.

7.0 Conclusion & Recommendations

The proposed development can be serviced for water and sanitary in accordance with the Town of Halton Hills and Halton Region requirements and standards. Our conclusions and recommendations include:

1. Water demand for the proposed development can be provided by a connection to the future 300 mm dia. watermain on Eighth Line. Internal water servicing for the proposed development will be provided using a looped 200 mm dia. water service.

2. Sanitary flow for the proposed development can be provided by a connection to the future 1200 mm dia. sanitary trunk sewer on Eighth Line. Internal sanitary servicing for the proposed development will be provided using an internal network of 250mm diameter sanitary sewers.

3. Stormwater quantity control is per the unit flow rate and cumulative unitary volume determined by MGM as part of the Scoped SWS. Storage is proposed on site to provide control of the 100-year storm through underground cisterns, while volume required in excess of the 100-year storm event will be provided through surface storage. The two catchments within the developable area will outlet to two separate headwalls discharging flows to the watercourse.

4. Stormwater quality control for the proposed development will be met by Jellyfish Filter systems, providing the minimum 80% removal of total suspended solids on an annual loading basis for 90% of runoff leaving the site.

5. Site-specific and feature-based water balance will be provided through the use the LIDs at the detailed design stage.

Based on the conclusions and recommendations indicated above, the Site can be serviced according to the Town of Halton Hills and Halton Region requirements subject to the municipal servicing strategy that will be outlined in the Scoped Area Servicing Plan to be submitted in the future under separate cover. We therefore recommend approval of the Planning Applications for the proposed development from the perspective of functional servicing requirements.

Respectfully submitted,

C.F. CROZIER & ASSOCIATES INC.

Hamdy Shafi, P.Eng.
Project Manager

C.F. CROZIER & ASSOCIATES INC.

Andrew Farina, P.Eng.
Project Engineer

C.F. CROZIER & ASSOCIATES INC.

Nick Mocan, M.Sc., P.Eng.
President

am/ic

\\1800\1805 - Gilbach Real Estate\5424 - Steeles & Eighth Line Waterpark\Reports\2022.03.15 (1805-5424)_FSRSWM.docx

APPENDIX A

Background Information

LPAT File No. PL180499

LOCAL PLANNING APPEAL TRIBUNAL

PROCEEDING COMMENCED UNDER subsection 17(24) of the *Planning Act*, R.S.O. 1990, c. P.13, as amended

Appellant:	Hodero Holdings Limited
Appellant:	Ministry of Municipal Affairs
Subject:	Proposed Official Plan Amendment No. OPA 47
Municipality:	Region of Halton
LPAT Case No.:	PL180499
LPAT File No.:	PL180499
LPAT Case Name:	Hodero Holdings Limited, MMAH v. Halton (Region)

MINUTES OF SETTLEMENT

BETWEEN

THE REGIONAL MUNICIPALITY OF HALTON ("**the Region**")

- and -

THE CORPORATION OF THE TOWN OF HALTON HILLS ("**the Town**")

- and -

8079 EIGHTH LINE HALTON HILLS INC.

- and -

HODERO HOLDINGS LTD.

WHEREAS 8079 Eighth Line Halton Hills Inc. owns lands located at the north east corner of Steeles Avenue and Eighth Line in the Town of Halton Hills, municipally addressed as 8079 Eighth Line, and legally described in Land Registry Office #20 in PIN 25025-0078 (LT) as PT LT 1 CON 9 ESQ, BEING PART 1, PLAN 20R20358; HALTON HILLS and shown on **Attachment 1** hereto ("**the Hodero Lands**");

AND WHEREAS 8079 Eighth Line Halton Hills Inc. and Hodero Holdings Ltd. are associated companies (collectively referred to as "**Hodero**");

AND WHEREAS Hodero Holdings Ltd. has appealed Regional Official Plan Amendment No. 47 ("**ROPA 47**") to the Local Planning Appeal Tribunal ("**the Tribunal**");

AND WHEREAS Hodero Holdings Ltd., the Region and the Town are parties to the hearing to be scheduled before the Tribunal and have agreed to resolve Hodero Holdings Ltd.'s appeal of ROPA 47 on the terms and conditions set out in these Minutes of Settlement;

AND WHEREAS Hodero proposes to develop the Hodero Lands for a major employment use and has advised that it intends to seek the required planning approvals as outlined in these Minutes of Settlement;

AND WHEREAS the Hodero development proposal ("**the development proposal**") is for a hotel, conference centre, waterpark and entertainment facility on the Hodero Lands;

AND WHEREAS the Province of Ontario ("**the Province**") in 2019 is proposing to restart the GTA West Corridor environmental assessment;

AND WHEREAS Regional Official Plan Amendment No. 43 ("**ROPA 43**") identifies corridor protection for a GTA West Corridor as well as corridor protection for the Halton-Peel Boundary Area Transportation Study ("**HPBATS**") which may affect the planning policy framework for the Hodero Lands;

AND WHEREAS the Region, the Town and Hodero **("the Parties"** and each a **"Party")** have agreed to request that the Province confirm that the Hodero Lands are not part of the GTA West Corridor protection area;

NOW THEREFORE, in consideration of the mutual covenants herein and other good and valuable consideration and the sum of TWO dollars mutually exchanged between the Parties, the receipt and sufficiency of which consideration is acknowledged by the Parties, the Parties agree as follows:

1. The recitals are true.

2. The Parties shall jointly request that the Tribunal allow Hodero's appeal of ROPA 47 in part and dismiss the remainder of the appeal, with ROPA 47 being modified as it relates to the Hodero Lands on consent as follows:

> "Notwithstanding Section 77(16) of this Plan, the lands municipally known as 8079 Eighth Line and part of Lot 1, Concession IX, former Township of Esquesing, in the Town of Halton Hills may be permitted to develop prior to 2021 in accordance with the other *policies* of this Plan, provided that a Local Official Plan Amendment is approved that:
>
> a) demonstrates how the lands can be integrated into an *Area-Specific Plan*, including by addressing the appropriate requirements of Section 77(5) of this Plan; and
> b) supports the development of a major employment use."

The Parties agree that the Region will determine the location of the above policy in the ROP prior to the modification being jointly recommended to the Tribunal for approval.

3. Hodero shall seek approval from the Tribunal for the modification of ROPA 47 as set out in paragraph 2 and Hodero shall call evidence in support of said modification. The Region and the Town shall support such approval at a settlement hearing.

4. It is understood and acknowledged by the Parties that the Region and the Town have specifically agreed to settle the appeal by Hodero Holdings Ltd. on the specific and express understanding that this settlement is conditional and contingent on the acceptance by the Tribunal of the modification as set out in paragraph 2. Should the Tribunal not grant the relief as set out in paragraph 2, then it is agreed that this settlement is null and void.

5. The Parties agree that no Party shall seek costs against any other Party for the proceedings at the Tribunal related to ROPA 47 in LPAT Case No. PL180499.

6. Hodero agrees that all applications in support of its development proposal on the Hodero Lands, including those for the Town Official Plan Amendment, the Zoning By-law Amendment and the Site Plan, shall address comprehensive planning considerations and support the development of a major employment use. It is acknowledged that these Minutes of Settlement in no way predetermine, fetter or otherwise limit Town Council or Regional Council decision-making on such applications, including whether the applications appropriately address the comprehensive planning considerations and whether the development proposal constitutes a major employment use.

7. Hodero agrees to further the development proposal by filing the Town Official Plan Amendment application on or before October 1, 2020, which date may be extended on consent of the Parties. Hodero further acknowledges that the Town Official Plan Amendment must be supported by the range of studies required as part of a complete application, and must address F10.4 of OPA 10, being the phasing policies in the Town's Official Plan. In addition, at minimum, the Town Official Plan Amendment application must be supported by the following studies based on Terms of Reference acceptable to the Town and the Region in order to demonstrate how the comprehensive planning considerations have been addressed, including the integration of the Hodero Lands into an Area-Specific Plan:

    a) planning justification report that demonstrates, among other things, how section 77(5) of the Regional Official Plan and section D3.5.4.4.3 of the Town Official Plan are met;
    b) a land use compatibility evaluation addressing existing residential development in the vicinity of the development;
    c) a commercial needs study based on the development proposal being a major employment generating commercial use;
    d) scoped subwatershed study;
    e) servicing report; and

f) traffic study.

8. The Parties acknowledge that Hodero shall bring forward a development proposal that will be integrated with the Town's adopted Premier Gateway Phase 1B Secondary Plan (**"LOPA 31A"** and **"LOPA 31B"**), which is pending approval by the Region. The Parties agree that Hodero may rely on existing work carried out by Town for LOPA 31A and LOPA 31B and augment that work as required in support of its development proposal and demonstration of comprehensive planning considerations. Further, the Town and the Region agree to scope the Terms of Reference for the studies referenced in paragraph 7, where appropriate, in recognition of the work completed in these prior Town studies.

9. Hodero agrees that it shall not appeal any approval of LOPA 31A by the Region, unless there are significant modifications by the Region to such approval. It is agreed by Hodero that unless the Town appeals the Region's decision on LOPA 31A that the modifications are deemed to be insignificant, and Hodero will therefore waive any appeal rights it may have had.

10. Hodero agrees that it shall not appeal any approval of LOPA 31B by the Region, unless there are significant modifications by the Region to such approval. It is agreed by Hodero that unless the Town appeals the Region's decision on LOPA 31B that the modifications are deemed to be insignificant, and Hodero will therefore waive any appeal rights it may have had.

11. The Parties acknowledge that the Province through the Ministry of Transportation has resumed Stage 2 of the Greater Toronto Area West Transportation Corridor Route Planning and Environmental Assessment Study. The Hodero Lands are located outside the 2015 GTA West Focused Analysis Area that is in place for the interim while the Province's Project Team updates and completes the route evaluation. The Hodero Lands are also located outside of the Proposed Halton-Peel Freeway Corridor identified conceptually on Exhibit 8-3 of the final report for HPBATS dated May 2010, which final corridor alignment has yet to be determined. As such, the Parties agree to request the Province to confirm that any planning instruments related to the GTA West Corridor will not require the Hodero Lands to be included in the corridor protection area. Should the Province so confirm, the development proposal shall be processed in the usual course, notwithstanding that the Hodero Lands are currently partially identified within the ROPA 43 HPBATS/GTA West Corridor Protection Area. The Region shall, with the support of the Town, seek to modify ROPA 43 accordingly at the Tribunal in LPAT Case No. PL140744.

12. These Minutes of Settlement are conditional upon approval by the Council of the Town and the Region. Should such approval not be given, it is agreed that these Minutes of Settlement are null and void *ab initio* and do not bind any of the Parties to these Minutes of Settlement whatsoever.

13. Should these Minutes of Settlement not be approved as required under the aforementioned clause, the Parties agree that the terms and obligations of these Minutes of Settlement shall not be referenced in the subsequent Tribunal hearing.

14. These Minutes of Settlement shall enure to the benefit of, and be binding upon the Parties and their respective successors and assigns.

15. The Parties hereto agree to execute such further documents and cause the doing of such acts and cause the execution of such further documents that are within their power as any Party may reasonably request be done or executed, in order to give full effect to the provisions of these Minutes of Settlement.

16. These Minutes of Settlement may be executed in multiple counterparts, each of which shall be deemed to be an original, and all of which shall constitute one Minutes of Settlement. The Parties further agree that each Party shall countersign copies of the document in order that each Party has an original Minutes of Settlement executed by all the Parties, and same shall be provided on a timely basis.

IN WITNESS WHEREOF, the Parties have executed these Minutes of Settlement as of the dates indicated below:

THE REGIONAL MUNICIPALITY OF HALTON

November 26, 2019

Per: _____

Bob Gray, Acting Commissioner, Legislative and Planning Services and Corporate Counsel

THE CORPORATION OF THE TOWN OF HALTON HILLS

November , 2019

Per: _____

By its solicitors, Thomson, Rogers

8079 EIGHTH LINE HALTON HILLS INC.

November , 2019

Per: _____

Name:

Title:

I have the authority to bind the Corporation.

14. These Minutes of Settlement shall enure to the benefit of, and be binding upon the Parties and their respective successors and assigns.

15. The Parties hereto agree to execute such further documents and cause the doing of such acts and cause the execution of such further documents that are within their power as any Party may reasonably request be done or executed, in order to give full effect to the provisions of these Minutes of Settlement.

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Per:_____

Bob Gray, Acting Commissioner, Legislative and Planning Services and Corporate Counsel

THE CORPORATION OF THE TOWN OF HALTON HILLS

November 26, 2019

Per:_____

By its solicitors, Thomson, Rogers

8079 EIGHTH LINE HALTON HILLS INC.

November , 2019

Per:_____

Name:

Title:

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THE REGIONAL MUNICIPALITY OF HALTON

November , 2019

Per: _____

Bob Gray, Acting Commissioner, Legislative and Planning Services and Corporate Counsel

THE CORPORATION OF THE TOWN OF HALTON HILLS

November , 2019

Per: _____

By its solicitors, Thomson, Rogers

8079 EIGHTH LINE HALTON HILLS INC.

November 26, 2019

Per: _____

Name: GLEN HANSEN

Title: PRESIDENT

I have the authority to bind the Corporation.

HODERO HOLDINGS LTD.

November 26, 2019

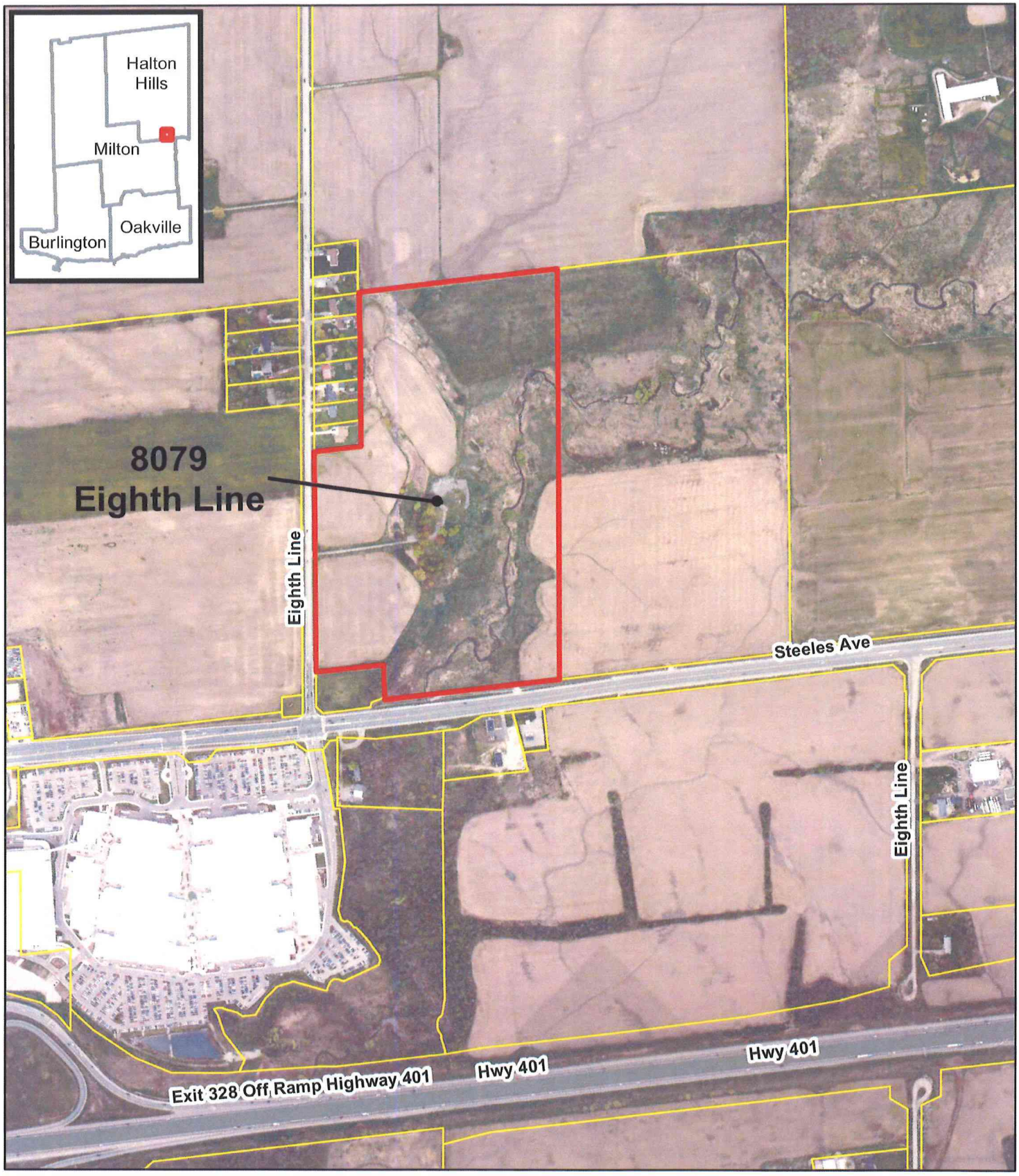
Per: _____

Name: GLEN HANSEN

Title: PRESIDENT

I have the authority to bind the Corporation.

Attachment 1



8079 Eighth Line

Hodero Lands
Parcels

0 50 100 200 300 400 Meters

DEVELOPMENT BLOCK #1
Area: 1.64 ha / 4.06 ac

DEVELOPMENT BLOCK #2
Area: 0.09 ha / 0.22 ac

FUTURE DEVELOPMENT BLOCK #3
Area: 0.49 ha / 1.21 ac

Part 1
Area: 903.59m²

Part 2
Area: 3,001.14m²

Part 3
Area: 477.23m²

Part 4
Area: 599.13m²

Part 5
Area: 1,512.01m²

DEVELOPMENT BLOCK #4
Area: 5.57 ha / 13.76 ac

Spa
Total GFA: 1,185.55m²
(12,761.20ft²)
(Not including outdoor amenities)

Flying Theatre
Total GFA: 3,000.00m²
(32,291.73ft²)

Hotel
8 Storeys - 350 Rooms
GFA: 3,701.86m²
(39,846.52ft²) per floor

Lobby GFA: 501.12m²
(5,394.02ft²)

Arcade
GFA: 564.37m²
(6,074.83ft²)

Outdoor Amenity Area
(0.21 ha / 0.51 ac)

Waterpark Guest Services
GFA: 2,166.99m²
(23,325.30ft²)

Food Hall
GFA: 1,405.06m²
(15,123.90ft²)

Family Entertainment Centre / Convention Centre
GFA: 2,811.40m²
(30,261.63ft²)

Waterpark
GFA: 7,599.22m²
(81,797.37ft²)

Restaurant 1
GFA: 464.40m²
(4,998.79ft²)

Restaurant Patio

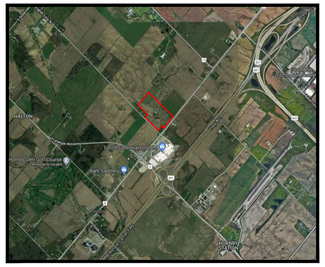
Drop Off Area

Loading Area and Bus Parking

~7.5m Road Widening

~7.5m Road Widening

KEY MAP:



LEGEND:

- Watercourse (MNRF)
- Natural Heritage Features
- Property Line
- Limits of Development
- Road Widening
- Parking (to be detailed later)
- Proposed Bus Route
- Proposed Bus Stops
- Temporary Working Easement
- Permanent Easement

STATISTICS:

Site Area: 19.06 ha / 47.10 ac

Development Area: 7.79 ha / 19.25 ac

Natural Heritage Area: 11.27 ha / 27.86 ac

Use:	Area:
Lobby	501.12m² / 5,394.02 ft²
Hotel	8 Storeys - 3,701.86m² / 39,846.52ft²
Food Hall	1,405.06m² / 15,123.90 ft²
Waterpark	7,599.22m² / 81,797.37 ft²
Waterpark Guest Services	2,166.99m² / 23,325.30 ft²
Arcade	564.37m² / 6,074.83 ft²
Family Entertainment / Convention Centre	2,811.40m² / 30,261.63 ft²
Restaurant	464.40m² / 4,998.79 ft²
Flying Theatre	3,000.00m² / 32,291.73 ft²
Spa	1,185.55m² / 12,761.20 ft²

Concept Plan

Gilbach (Halton Hills) Inc.
8070 Eighth Line

Scale: 1:1,000

CORBETT LAND STRATEGIES INC.
VISION • EXPERTISE
5045 South Service Road, Suite 301
Burlington, ON L7L 5Y7
corbettlandstrategies.ca

APPENDIX B

Water Demand Calculations

Project: 8079 Eighth Line
Project No.: 1805-5424
Date: 3/8/2022
Designed By: AM
Checked By: HS

WATER DEMAND CALCULATIONS
8079 EIGHTH LINE - STEELES AVE & EIGHTH LINE WATERPARK DEVELOPMENT
TOWN OF HALTON HILLS, HALTON REGION

Region of Halton

Total Area:	**19.06**	**ha**	Total Developable Area, refer to Concept Plan prepared by Corbett Lan Strategies Inc. dated January 2022, this area does not include the Natural Heritage Features.
Development Block 1 (Spa & Flying Theatre)	**1.64**	ha	Note - Only Development Block 1 and Block 4 shall be considered as a part of this application.
Development Block 2 (TBD)	**0.09**	ha	
Development Block 3 (Drive-Thru Restaurant)	**0.49**	ha	
Development Block 4 (Waterpark, Hotel, and Ancilliary Buildings)	**5.57**	ha	
Total Developable Area:	**7.79**	**ha**	
Occupancy:	Light Commercial		Population estimate based on area and Halton Region Water and Wastewater Linear Design Manual, 2019 (Sec 2.3, Table 2-1)
Equivalent Population Density:	90	persons/ha	
Population Development Block 1	148	persons	
Population Development Block 4	502	persons	
Design Population:	**650**	**persons**	
Max Day Factor:	2.25		Average Daily Demand and Factors based on area and Halton Region Water and Wastewater Linear Design Manual, 2019 (Sec 2.3, Table 2-1 and Sec 2.4, Table 2-2)
Peak Hour Factor:	2.25		
Average Daily Demand:	0.275	m^3/cap/day	
Average Day Flow:	179,000	L/day	
Development Block 1	0.47	L/s	
Development Block 4	1.60	L/s	
	2.07	**L/s**	
Maximum Day Flow:	403,000	L/day	
Development Block 1	1.07	L/s	
Development Block 4	3.59	L/s	
	4.66	**L/s**	
Peak Hour Flow:	403,000	L/day	
Development Block 1	1.07	L/s	
Development Block 4	3.59	L/s	
	4.66	**L/s**	

References

CROZIER & ASSOCIATES Consulting Engineers

Steeles Avenue & Eighth Line Waterpark Development
Fire Protection Volume Calculation
CFCA File: 1805-5424

Date: 2/18/2022
Design: AM
Check: HS

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

where

F = the required fire flow in litres per minute

C = coefficient related to the type of construction:

=	1.5	for wood frame construction (structure essentially all combustible)
=	1.0	for ordinary construction (brick or other masonry walls, combustible floor and interior)
=	0.8	for non-combustible construction (unprotected metal structural components)
=	0.6	for fire-resistive construction (fully protected frame, floors, roof)

A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings

Area = 1,186 sq.m

C = 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)

Therefore F = 7,575 L/min

Fire flow determined above shall not exceed:

30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No Change)		

Non-Combustible	-25% reduction

Spa use so assume non-combustible

-1,894 L/min reduction
5,681 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduced by up to 50% for complete automatic sprinkler protection. The credit for the system will be a maximum of 30% for an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards.

As part of this analysis, the building will have automatic sprinkler protection: **Assume 30% according to automatic sprinkler system**

1,704 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings

Name		Distance (m)	Charge (%)	Surcharge (L/s)
E	Food Hall	>45	0%	-
W	N/A	>45	0%	-
N	Spa	21	10%	568
S	Waterpark	>45	0%	-

568 L/min Surcharge

Determine Required Fire Flow

No.1	7,575		
No. 2	-1,894 reduction		
No. 3	-1,704 reduction		
No. 4	568 surcharge		
Required Flow:	**4,545 L/min**		
Rounded to nearest 1000 L/min:	**5,000 L/min**	or	**83.3 L/s**
			1,321 USGPM

Required Duration of Fire Flow

Flow Required L/min	Duration (hours)
2000 or less	1.0
3,000	1.25
4,000	1.5
5,000	**1.75**
6,000	2
8,000	2
10,000	2
12,000	2.5
14,000	3
16,000	3.5
18,000	4
20,000	4.5
22,000	5
24,000	5.5
26,000	6
28,000	6.5
30,000	7
32,000	7.5
34,000	8
36,000	8.5
38,000	9
40,000 and over	9.5

CROZIER & ASSOCIATES Consulting Engineers

Steeles Avenue & Eighth Line Waterpark Development **Date:** 2/18/2022
Fire Protection Volume Calculation **Design:** AM
CFCA File 1805-5424 **Check:** HS

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \text{sqrt } A$$

where

F = the required fire flow in litres per minute

C = coefficient related to the type of construction:
- = 1.5 for wood frame construction (structure essentially all combustible)
- = 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
- = 0.8 for non-combustible construction (unprotected metal structural components)
- = 0.6 for fire-resistive construction (fully protected frame, floors, roof)

A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings

Area = 3,000 sq.m

C = 0.8 for non-combustible construction (unprotected metal structural components)

Therefore F = 9,640 L/min

Fire flow determined above shall not exceed:

30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No Change)		

Non-Combustible	-25% reduction

Flying theatre use so assume non-combustible

-2,410 L/min reduction
7,230 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduced by up to 50% for complete automatic sprinkler protection. The credit for the system will be a maximum of 30% for an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards.

As part of this analysis, the building will have automatic sprinkler protection: **Assume 30% according to automatic sprinkler system**

2,169 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings

Name		Distance (m	Charge (%)	Surcharge (L/s)
E	Food Hall	>45	0%	-
W	N/A	>45	0%	-
N	Spa	21	10%	723
S	Waterpark	>45	0%	-

723 L/min Surcharge

Determine Required Fire Flow

No.1	9,640	
No. 2	-2,410	reduction
No. 3	-2,169	reduction
No. 4	723	surcharge
Required Flow:	**5,784 L/min**	
Rounded to nearest 1000 L/min:	**6,000 L/min**	or **100.0 L/s** (1,585 USGPM)

Required Duration of Fire Flow

Flow Required L/min	Duration (hours)
2000 or less	1.0
3,000	1.25
4,000	1.5
5,000	1.75
6,000	**2**
8,000	2
10,000	2
12,000	2.5
14,000	3
16,000	3.5
18,000	4
20,000	4.5
22,000	5
24,000	5.5
26,000	6
28,000	6.5
30,000	7
32,000	7.5
34,000	8
36,000	8.5
38,000	9
40,000 and over	9.5

CROZIER & ASSOCIATES Consulting Engineers

Steeles Avenue & Eighth Line Waterpark Development
Fire Protection Volume Calculation
CFCA File: 1805-5424

Date: 2/18/2022
Design: AM
Check: ADF

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

where

F = the required fire flow in litres per minute

C = coefficient related to the type of construction:

=	1.5	for wood frame construction (structure essentially all combustible)
=	1.0	for ordinary construction (brick or other masonry walls, combustible floor and interior)
=	0.8	for non-combustible construction (unprotected metal structural components)
=	0.6	for fire-resistive construction (fully protected frame, floors, roof)

A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings

Area = 464 sq.m
C = 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)

Therefore F = 4,739 L/min

Fire flow determined above shall not exceed:

30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No Change)		

Combustible	0% reduction

Restauarnt therefore assume combustible

0 L/min reduction
4,739 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduced by up to 50% for complete automatic sprinkler protection. The credit for the system will be a maximum of 30% for an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards.

As part of this analysis, the building will have automatic sprinkler protection: **Assume 30% according to automatic sprinkler system**

1,422 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings

Name		Distance (m)	Charge (%)	Surcharge (L/s)
E	N/A	>45	0%	-
W	N/A	>45	0%	-
N	Residential	25	10%	474
S	Commercial	46	0%	-

474 L/min Surcharge

Determine Required Fire Flow

No.1	4,739	
No. 2	0 reduction	
No. 3	-1,422 reduction	
No. 4	474 surcharge	
Required Flow:	**3,791 L/min**	
Rounded to nearest 1000 L/min:	**4,000 L/min**	or **66.7 L/s** (1,057 USGPM)

Required Duration of Fire Flow

Flow Required L/min	Duration (hours)
2000 or less	1.0
3,000	1.25
4,000	**1.5**
5,000	1.75
6,000	2
8,000	2
10,000	2
12,000	2.5
14,000	3
16,000	3.5
18,000	4
20,000	4.5
22,000	5
24,000	5.5
26,000	6
28,000	6.5
30,000	7
32,000	7.5
34,000	8
36,000	8.5
38,000	9
40,000 and over	9.5

CROZIER & ASSOCIATES Consulting Engineers

Steeles Avenue & Eighth Line Waterpark Development
Fire Protection Volume Calculation
CFCA File: 1805-5424

Date: 2/18/2022
Design: AM
Check: HS

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

where

F = the required fire flow in litres per minute

C = coefficient related to the type of construction:

=	1.5	for wood frame construction (structure essentially all combustible)
=	1.0	for ordinary construction (brick or other masonry walls, combustible floor and interior)
=	0.8	for non-combustible construction (unprotected metal structural components)
=	0.6	for fire-resistive construction (fully protected frame, floors, roof)

A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings

Area = 3,702 sq.m
5,553 sq.m Area of the largest floor plus 25% of each of the two immediately adjoining floors

C = 0.6 for fire-resistive construction (fully protected frame, floors, roof)

Therefore F = 9,836 L/min

Fire flow determined above shall not exceed:

30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No Change)		

Limited Combustible	-15% reduction

Hotel use so assume limited combustible

-1,475 L/min reduction
8,361 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduced by up to 50% for complete automatic sprinkler protection. The credit for the system will be a maximum of 30% for an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards.

As part of this analysis, the building will have automatic sprinkler protection: **Assume 50% according to fully supervised automatic sprinkler system**

4,180 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings

Name		Distance (m)	Charge (%)	Surcharge (L/s)
E	Lobby	0	25%	2,090
W	N/A	0	25%	2,090
N	Restaurant	46	0%	-
S	Convention Centre/Guest Services	0	25%	2,090
				6,271 L/min Surcharge

Determine Required Fire Flow

No.1	9,836		
No. 2	-1,475 reduction		
No. 3	-4,180 reduction		
No. 4	6,271 surcharge		
Required Flow:	**10,451 L/min**		
Rounded to nearest 1000 L/min:	**10,000 L/min**	or	**166.7 L/s**
			2,642 USGPM

Required Duration of Fire Flow

Flow Required L/min	Duration (hours)
2000 or less	1.0
3,000	1.25
4,000	1.5
5,000	1.75
6,000	2
8,000	2
10,000	**2**
12,000	2.5
14,000	3
16,000	3.5
18,000	4
20,000	4.5
22,000	5
24,000	5.5
26,000	6
28,000	6.5
30,000	7
32,000	7.5
34,000	8
36,000	8.5
38,000	9
40,000 and over	9.5

CROZIER & ASSOCIATES Consulting Engineers

Steeles Avenue & Eighth Line Waterpark Development
Fire Protection Volume Calculation
CFCA File: 1805-5424

Date: 2/18/2022
Design: AM
Check: HS

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

where

F = the required fire flow in litres per minute

C = coefficient related to the type of construction:

=	1.5	for wood frame construction (structure essentially all combustible)
=	1.0	for ordinary construction (brick or other masonry walls, combustible floor and interior)
=	0.8	for non-combustible construction (unprotected metal structural components)
=	0.6	for fire-resistive construction (fully protected frame, floors, roof)

A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings

Area = 7,599 sq.m

C = 0.8 for non-combustible construction (unprotected metal structural components)

Therefore F = 15,343 L/min

Fire flow determined above shall not exceed:

30,000 L/min for wood frame construction
30,000 L/min for ordinary construction
25,000 L/min for non-combustible construction
25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No Change)		

Non-Combustible	-25% reduction

Waterpark use so assume non-combustible

-3,836 L/min reduction
11,507 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduced by up to 50% for complete automatic sprinkler protection. The credit for the system will be a maximum of 30% for an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards.

As part of this analysis, the building will have automatic sprinkler protection: **Assume 50% according to fully supervised automatic sprinkler system**

5,753 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings

Name		Distance (m)	Charge (%)	Surcharge (L/s)
E	Food Hall	0	25%	2,877
W	N/A	>45	0%	-
N	Guest Services	0	25%	2,877
S	N/A	>45	0%	-

5,753 L/min Surcharge

Determine Required Fire Flow

No.1	15,343		
No. 2	-3,836 reduction		
No. 3	-5,753 reduction		
No. 4	5,753 surcharge		
Required Flow:	**11,507 L/min**		
Rounded to nearest 1000 L/min:	**12,000 L/min**	or	**200.0 L/s**
			3,170 USGPM

Required Duration of Fire Flow

Flow Required L/min	Duration (hours)
2000 or less	#
3,000	1
4,000	2
5,000	2
6,000	2
8,000	2
10,000	2
12,000	**3**
14,000	3
16,000	4
18,000	4
20,000	5
22,000	5
24,000	6
26,000	6
28,000	7
30,000	7
32,000	8
34,000	8
36,000	9
38,000	9
40,000 and over	#

CROZIER & ASSOCIATES Consulting Engineers

Steeles Avenue & Eighth Line Waterpark Development **Date:** 2/18/2022
Fire Protection Volume Calculation **Design:** AM
CFCA File 1805-5424 **Check:** HS

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

1. An estimate of fire flow required for a given area may be determined by the formula:

$$F = 220 * C * \sqrt{A}$$

where

F = the required fire flow in litres per minute

C = coefficient related to the type of construction:
- = 1.5 for wood frame construction (structure essentially all combustible)
- = 1.0 for ordinary construction (brick or other masonry walls, combustible floor and interior)
- = 0.8 for non-combustible construction (unprotected metal structural components)
- = 0.6 for fire-resistive construction (fully protected frame, floors, roof)

A = The total floor area in square metres (including all storeys, but excluding basements at least 50 percent below grade) in the building considered.

Proposed Buildings

Area = 7,449 sq.m Ancillary buildings include Lobby, Food Hall, Guest Service, Arcade, and Convention Centre

C = 0.8 for non-combustible construction (unprotected metal structural components)

Therefore F = 15,190 L/min

Fire flow determined above shall not exceed:
- 30,000 L/min for wood frame construction
- 30,000 L/min for ordinary construction
- 25,000 L/min for non-combustible construction
- 25,000 L/min for fire-resistive construction

2. Values obtained in No. 1 may be reduced by as much as 25% for occupancies having low contents fire hazard or may be increased by up to 25% surcharge for occupancies having a high fire hazard.

Non-Combustible	-25%	Free Burning	15%
Limited Combustible	-15%	Rapid Burning	25%
Combustible	0% (No Change)		

Non-Combustible	-25% reduction

Ancillary use so assume non-combustible

-3,798 L/min reduction
11,393 L/min

Note: Flow determined shall not be less than 2,000 L/min

3. Sprinklers - The value obtained in No. 2 above maybe reduced by up to 50% for complete automatic sprinkler protection. The credit for the system will be a maximum of 30% for an adequately designed system conforming to NFPA 13 and other NFPA sprinkler standards.

As part of this analysis, the building will have automatic sprinkler protection: **Assume 50% according to fully supervised automatic sprinkler system**

5,696 L/min reduction

Water Supply for Public Fire Protection - 1999
Fire Underwriters Survey

Part II - Guide for Determination of Required Fire Flow

4. Exposure - To the value obtained in No. 2, a percentage should be added for structures exposed within 45 metres by the fire area under consideration. The percentage shall depend upon the height, area, and construction of the building(s) being exposed, the separation, openings in the exposed building(s), the length and height of exposure, the provision of automatic sprinklers and/or outside sprinklers in the building(s) exposed, the occupancy of the exposed building(s) and the effect of hillside locations on the possible spread of fire.

Separation	Charge	Separation	Charge
0 to 3 m	25%	20.1 to 30 m	10%
3.1 to 10 m	20%	30.1 to 45 m	5%
10.1 to 20 m	15%		

Exposed buildings

Name		Distance (m	Charge (%)	Surcharge (L/s)
E	Food Hall	>45	0%	-
W	N/A	>45	0%	-
N	Hotel	0	25%	2,848
S	Waterpark	0	25%	2,848

5,696 L/min Surcharge

Determine Required Fire Flow

No.1	15,190	
No. 2	-3,798 reduction	
No. 3	-5,696 reduction	
No. 4	5,696 surcharge	
Required Flow:	**11,393 L/min**	
Rounded to nearest 1000 L/min:	**11,000 L/min** or	**183.3 L/s**
		2,906 USGPM

Required Duration of Fire Flow

Flow Required L/min	Duration (hours)
2000 or less	1.0
3,000	1.25
4,000	1.5
5,000	1.75
6,000	2
8,000	2
10,000	**2**
12,000	**2.5**
14,000	3
16,000	3.5
18,000	4
20,000	4.5
22,000	5
24,000	5.5
26,000	6
28,000	6.5
30,000	7
32,000	7.5
34,000	8
36,000	8.5
38,000	9
40,000 and over	9.5

APPENDIX C

Sanitary Flow Calculations

Project: 8079 Eighth Line
Project No.: 1805-5424
Date: 3/8/2022
Designed By: AM
Checked By: HS

SANITARY FLOW CALCULATIONS
STEELES AVE & EIGHTH LINE WATERPARK DEVELOPMENT
TOWN OF HALTON HILLS, HALTON REGION

Region of Halton

			References
Total Area:	**19.06**	**ha**	Total Developable Area, refer to Concept Plan prepared by Corbett Lan Strategies Inc. dated January 2022, this area does not include the Natural Heritage Features.
Development Block 1 (Spa & Flying Theatre)	**1.64**	ha	
Development Block 2 (TBD)	**0.09**	ha	
Development Block 3 (Drive-Thru Restaurant)	**0.49**	ha	
Development Block 4 (Waterpark, Hotel, and Ancilliary Buildings)	**5.57**	ha	
Total Developable Area:	**7.79**	**ha**	Note - Only Development Block 1 and Block 4 shall be considered as a part of this application.
Occupancy:	Light Commercial		
Equivalent Population Density:	90	persons/ha	
Population Development Block 1	148	persons	
Population Development Block 4	502	persons	
Design Population:	**650**	**persons**	Population estimate based on area and Halton Region Water and Wastewater Linear Design Manual, 2019 (Section 3.2, Table 3-2)
Peak Wastewater Flow Factor (M_e):	$0.8 * (1 + \frac{14}{4 + \sqrt{P}})$		Halton Region Water and Wastewater Linear Design Manual, 2019 (Sec 3.2.3.b)
where,	P= population in thousands		
Development Block 1 - M_e:	3.35		
Development Block 4 - M_e:	3.18		
Unit Sewage flow:	24.750	m^3/ha/day	
Infiltration Flow:	0.000286	m^3/ha/s	
Average Day Flow:			Halton Region Water and Wastewater Linear Design Manual, 2015 (Section 3.2.2, Table 3-2 and Section 3.2.4.a)
Development Block 1	0.47	L/s	
Development Block 4	1.60	L/s	
TOTAL	**2.07**	**L/s**	
Peak Flow:			
Development Block 1	1.58	L/s	
Development Block 4	5.07	L/s	
TOTAL	**6.65**	**L/s**	
Infiltration Flow:			
Development Block 1	0.47	L/s	
Development Block 4	1.59	L/s	
TOTAL	**2.06**	**L/s**	
Total Proposed Sanitary Flow:			
Development Block 1	2.04	L/s	
Development Block 4	6.67	L/s	
TOTAL	**8.71**	**L/s**	

APPENDIX D

Stormwater Management Calculations

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Saturday, March 05, 2022
Project Name	Steeles Ave. and Eighth Line
Project Number	Catchment 200 (Split 2)
Location	Halton Hills

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.
Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF10-15-4 is recommended to meet the water quality objective by treating a flow of 78.9 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 967 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF10-15-4	15	4	3.0	78.9	967

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

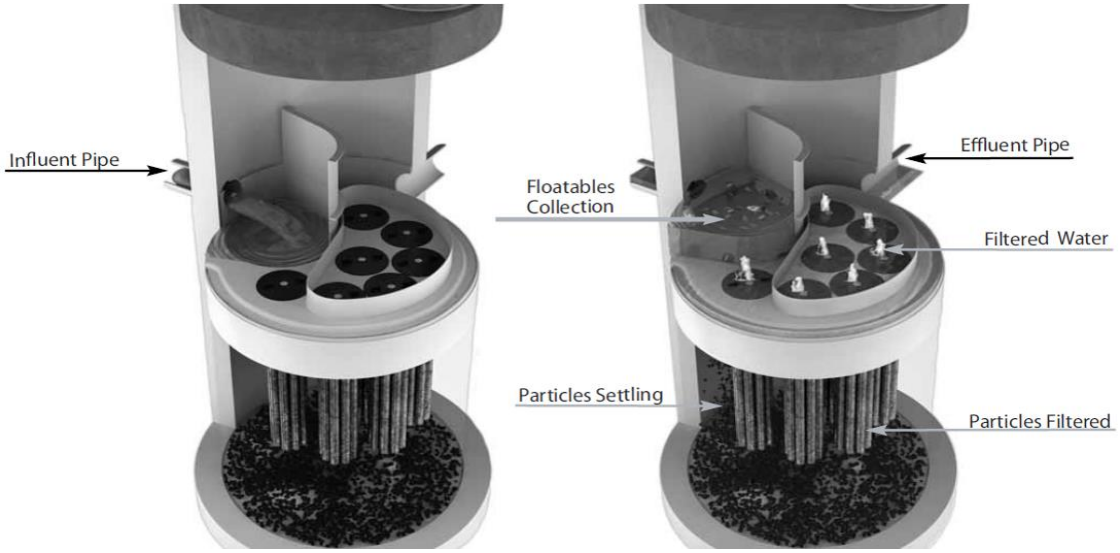
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 77% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 77%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Saturday, March 05, 2022
Project Name:	Steeles Ave. and Eighth Line
Project Number:	Catchment 200 (Split 2)
Location:	Halton Hills

Designer Information

Company:	C.F. Crozier & Associates Inc.
Contact:	Isabelle Cleroux
Phone #:	

Notes

Rainfall

Name:	TORONTO CENTRAL
State:	ON
ID:	100
Record:	1982 to 1999
Co-ords:	45°30'N, 90°30'W

Drainage Area

Total Area:	2.63 ha
Imperviousness:	100%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	**62.6 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 15527 m³, with a suspended sediment concentration of 60 mg/L.	**932 kg***

** Indicates that sediment loading is the limiting parameter in the sizing of this Jellyfish system*

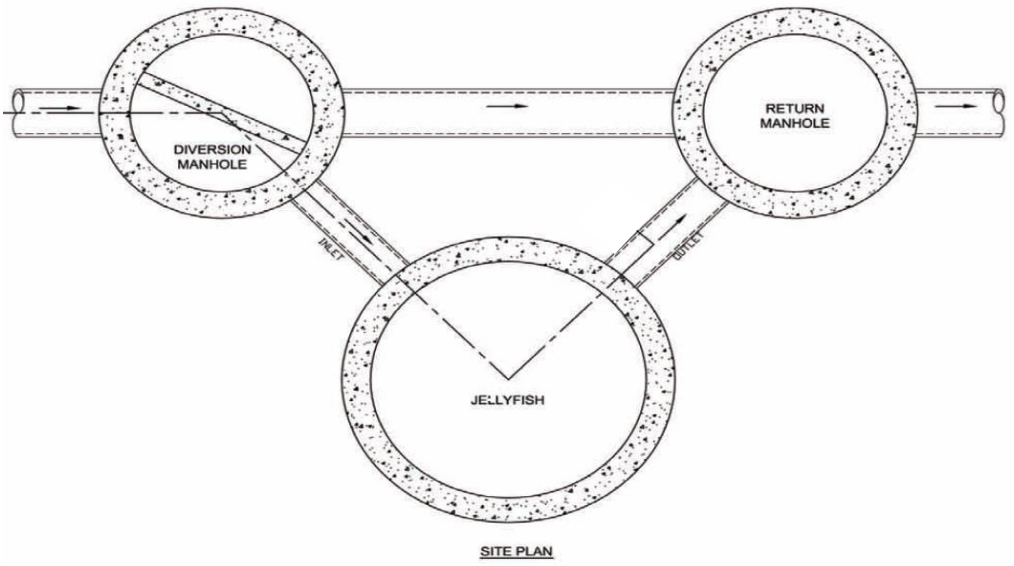
Recommendation

The Jellyfish Filter model JF10-15-4 is recommended to meet the water quality objective by treating a flow of 78.9 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 967 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	9	2	2.4	9252	1.42	1469	50.5	569
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	**15**	**4**	**3.0**	**14456**	**2.21**	**2302**	**78.9**	**967**
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

Jellyfish Filter Design Notes

- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



Jellyfish Filter Typical Layout

- Typically, 18 inches (457 mm) of driving head is designed into the system, calculated as the difference in elevation between the top of the diversion structure weir and the invert of the Jellyfish Filter outlet pipe. Alternative driving head values can be designed as 12 to 24 inches (305 to 610mm) depending on specific site requirements, requiring additional sizing and design assistance.
- Typically, the Jellyfish Filter is designed with the inlet pipe configured 6 inches (150 mm) above the outlet invert elevation. However, depending on site parameters this can vary to an optional configuration of the inlet pipe entering the unit below the outlet invert elevation.
- The Jellyfish Filter can accommodate multiple inlet pipes within certain restrictions.
- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
1.2	62º	150	200
1.8	59º	200	250
2.4	52º	250	300
3.0	**48º**	**300**	**450**
3.6	40º	300	450

- The Jellyfish Filter can be built at all depths of cover generally associated with conventional stormwater conveyance systems. For sites that require minimal depth of cover for the stormwater infrastructure, the Jellyfish Filter can be applied in a shallow application using a hatch cover. The general minimum depth of cover is 36 inches (915 mm) from top of the underslab to outlet invert.
- If driving head caclulations account for water elevation during submerged conditions the Jellyfish Filter will function effectively under submerged condtions.
- Jellyfish Filter systems may incorporate grated inlets depending on system configuration.
- For sites with water quality treatment flow rates or mass loadings that exceed the design flow rate of the largest standard Jellyfish Filter manhole models, systems can be designed that hydraulically connect multiple Jellyfish Filters in series or alternatively Jellyfish Vault units can be designed.

STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

Specifies requirements for construction and performance of an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS

ASTM C 891: Specification for Installation of Underground Precast Concrete Utility Structures
ASTM C 478: Specification for Precast Reinforced Concrete Manhole Sections
ASTM C 443: Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM D 4101: Specification for Copolymer steps construction

CAN/CSA-A257.4-M92
Joints for Circular Concrete Sewer and Culvert Pipe, Manhole Sections and Fittings Using Rubber Gaskets

CAN/CSA-A257.4-M92
Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

STANDARD OFFLINE
Jellyfish Filter Sizing Report

Project Information

Date	Saturday, March 05, 2022
Project Name	Steeles Ave. and Eighth Line
Project Number	Catchment 201
Location	Halton Hills

Jellyfish Filter Design Overview

This report provides information for the sizing and specification of the Jellyfish Filter. When designed properly in accordance to the guidelines detailed in the Jellyfish Filter Technical Manual, the Jellyfish Filter will exceed the performance and longevity of conventional horizontal bed and granular media filters.

Please see ***www.ImbriumSystems.com*** *for more information.*

Jellyfish Filter System Recommendation

The Jellyfish Filter model JF8-9-2 is recommended to meet the water quality objective by treating a flow of 50.5 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 569 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF8-9-2	9	2	2.4	50.5	569

The Jellyfish Filter System

The patented Jellyfish Filter is an engineered stormwater quality treatment technology featuring unique membrane filtration in a compact stand-alone treatment system that removes a high level and wide variety of stormwater pollutants. Exceptional pollutant removal is achieved at high treatment flow rates with minimal head loss and low maintenance costs. Each lightweight Jellyfish Filter cartridge contains an extraordinarily large amount of membrane surface area, resulting in superior flow capacity and pollutant removal capacity.

Maintenance

Regular scheduled inspections and maintenance is necessary to assure proper functioning of the Jellyfish Filter. The maintenance interval is designed to be a minimum of 12 months, but this will vary depending on site loading conditions and upstream pretreatment measures. Quarterly inspections and inspections after all storms beyond the 5-year event are recommended until enough historical performance data has been logged to comfortably initiate an alternative inspection interval.

Please see ***www.ImbriumSystems.com*** *for more information.*

Thank you for the opportunity to present this information to you and your client.

Performance

Jellyfish efficiently captures a high level of Stormwater pollutants, including:

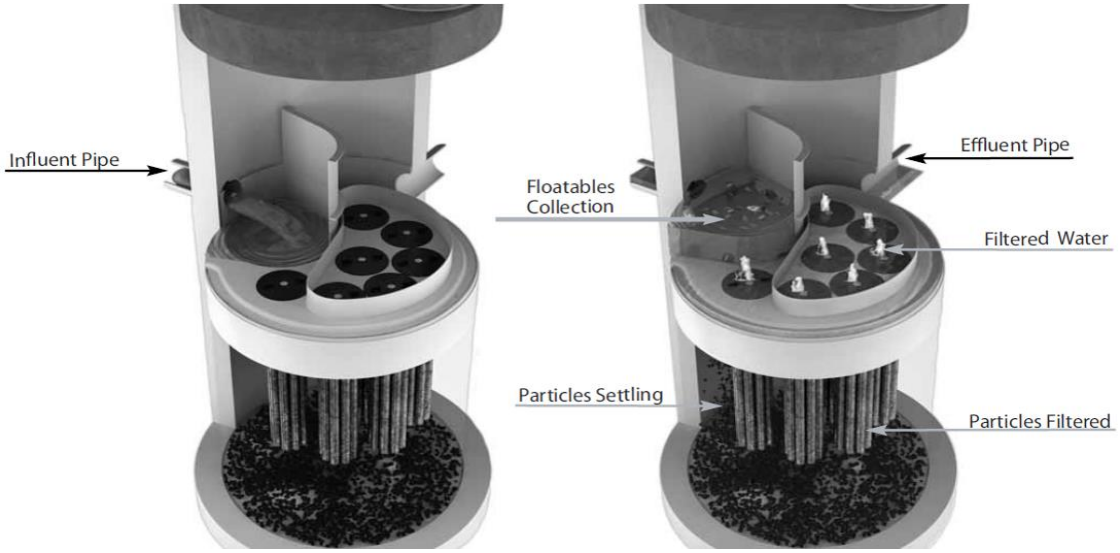
- ☑ 89% of the total suspended solids (TSS) load, including particles less than 5 microns
- ☑ 77% TP removal & 51% TN removal
- ☑ 90% Total Copper, 81% Total Lead, 70% Total Zinc
- ☑ Particulate-bound pollutants such as nutrients, toxic metals, hydrocarbons and bacteria
- ☑ Free oil, Floatable trash and debris

Field Proven Peformance

The Jellyfish filter has been field-tested on an urban site with 25 TARP qualifying rain events and field monitored according to the TARP field test protocol, demonstrating:

- A median TSS removal efficiency of 89%, and a median SSC removal of 99%;
- The ability to capture fine particles as indicated by an effluent d50 median of 3 microns for all monitotred storm events, and a median effluent turbidity of 5 NTUs;
- A median Total Phosphorus removal of 77%, and a median Total Nitrogen removal of 51%.

Jellyfish Filter Treatment Functions



Pre-treatment and Membrane Filtration

Jellyfish® Filter

Project Information

Date:	Saturday, March 05, 2022
Project Name:	Steeles Ave. and Eighth Line
Project Number:	Catchment 201
Location:	Halton Hills

Designer Information

Company:	C.F. Crozier & Associates Inc.
Contact:	Isabelle Cleroux
Phone #:	

Notes

Rainfall

Name:	TORONTO CENTRAL
State:	ON
ID:	100
Record:	1982 to 1999
Co-ords:	45°30'N, 90°30'W

Drainage Area

Total Area:	1.55 ha
Imperviousness:	100%

Upstream Detention

Peak Release Rate:	n/a
Pretreatment Credit:	n/a

Design System Requirements

Flow Loading	90% of the Average Annual Runoff based on 18 years of TORONTO CENTRAL rainfall data:	**38.9 L/s**
Sediment Loading	Treating 90% of the average annual runoff volume, 9188 m³, with a suspended sediment concentration of 60 mg/L.	**551 kg***

** Indicates that sediment loading is the limiting parameter in the sizing of this Jellyfish system*

Recommendation

The Jellyfish Filter model JF8-9-2 is recommended to meet the water quality objective by treating a flow of 50.5 L/s, which meets or exceeds 90% of the average annual rainfall runoff volume based on 18 years of TORONTO CENTRAL rainfall data for this site. This model has a sediment capacity of 569 kg, which meets or exceeds the estimated average annual sediment load.

Jellyfish Model	Number of High-Flo Cartridges	Number of Draindown Cartridges	Manhole Diameter (m)	Wet Vol Below Deck (L)	Sump Storage (m³)	Oil Capacity (L)	Treatment Flow Rate (L/s)	Sediment Capacity (kg)
JF4-1-1	1	1	1.2	2313	0.34	379	7.6	85
JF4-2-1	2	1	1.2	2313	0.34	379	12.6	142
JF6-3-1	3	1	1.8	5205	0.79	848	17.7	199
JF6-4-1	4	1	1.8	5205	0.79	848	22.7	256
JF6-5-1	5	1	1.8	5205	0.79	848	27.8	313
JF6-6-1	6	1	1.8	5205	0.79	848	28.6	370
JF8-6-2	6	2	2.4	9252	1.42	1469	35.3	398
JF8-7-2	7	2	2.4	9252	1.42	1469	40.4	455
JF8-8-2	8	2	2.4	9252	1.42	1469	45.4	512
JF8-9-2	**9**	**2**	**2.4**	**9252**	**1.42**	**1469**	**50.5**	**569**
JF8-10-2	10	2	2.4	9252	1.42	1469	50.5	626
JF10-11-3	11	3	3.0	14456	2.21	2302	63.1	711
JF10-12-3	12	3	3.0	14456	2.21	2302	68.2	768
JF10-12-4	12	4	3.0	14456	2.21	2302	70.7	796
JF10-13-4	13	4	3.0	14456	2.21	2302	75.7	853
JF10-14-4	14	4	3.0	14456	2.21	2302	78.9	910
JF10-15-4	15	4	3.0	14456	2.21	2302	78.9	967
JF10-16-4	16	4	3.0	14456	2.21	2302	78.9	1024
JF10-17-4	17	4	3.0	14456	2.21	2302	78.9	1081
JF10-18-4	18	4	3.0	14456	2.21	2302	78.9	1138
JF10-19-4	19	4	3.0	14456	2.21	2302	78.9	1195
JF12-20-5	20	5	3.6	20820	3.2	2771	113.6	1280
JF12-21-5	21	5	3.6	20820	3.2	2771	113.7	1337
JF12-22-5	22	5	3.6	20820	3.2	2771	113.7	1394
JF12-23-5	23	5	3.6	20820	3.2	2771	113.7	1451
JF12-24-5	24	5	3.6	20820	3.2	2771	113.7	1508
JF12-25-5	25	5	3.6	20820	3.2	2771	113.7	1565
JF12-26-5	26	5	3.6	20820	3.2	2771	113.7	1622
JF12-27-5	27	5	3.6	20820	3.2	2771	113.7	1679

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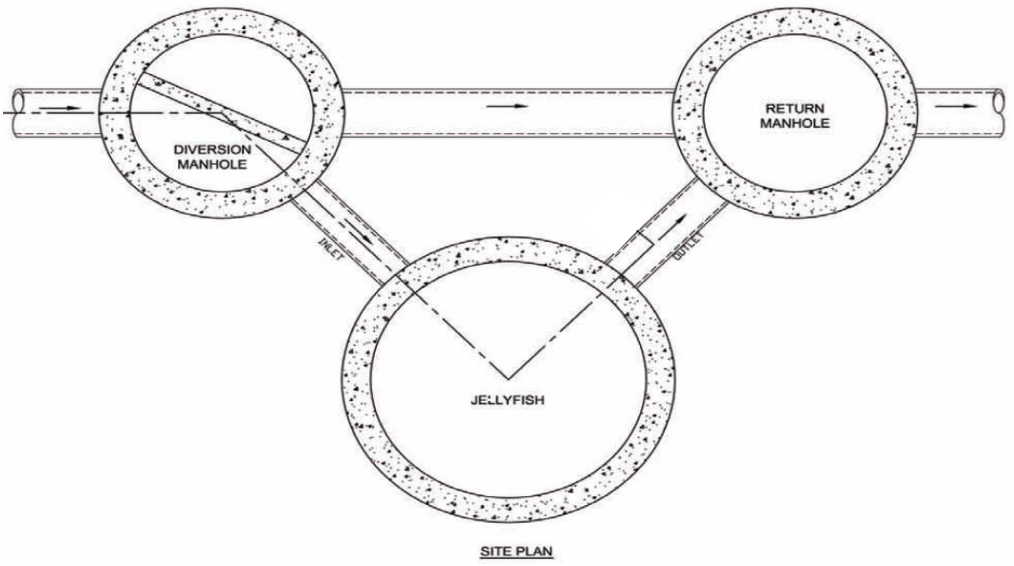
- Typically the Jellyfish Filter is designed in an offline configuration, as all stormwater filter systems will perform for a longer duration between required maintenance services when designed and applied in off-line configurations. Depending on the design parameters, an optional internal bypass may be incorporated into the Jellyfish Filter, however note the inspection and maintenance frequency should be expected to increase above that of an off-line system. Speak to your local representative for more information.



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- While the optional inlet below deck configuration offers 0 to 360 degree flexibility between the inlet and outlet pipe, typical systems conform to the following:

Model Diameter (m)	Minimum Angle Inlet / Outlet Pipes	Minimum Inlet Pipe Diameter (mm)	Minimum Outlet Pipe Diameter (mm)
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STANDARD SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

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Precast Reinforced Circular Concrete Manhole Sections, Catch Basins and Fittings

Canadian Highway Bridge Design Code

1.3 SHOP DRAWINGS

Shop drawings for the structure and performance are to be submitted with each order to the contractor. Contractor shall forward shop drawing submittal to the consulting engineer for approval. Shop drawings are to detail the structure's precast concrete and call out or note the fiberglass (FRP) internals/components.

1.4 PRODUCT SUBSTITUTIONS

No product substitutions shall be accepted unless submitted 10 days prior to project bid date, or as directed by the engineer of record. Submissions for substitutions require review and approval by the Engineer of Record, for hydraulic performance, impact to project designs, equivalent treatment performance, and any required project plan and report (hydrology/hydraulic, water quality, stormwater pollution) modifications that would be required by the approving jurisdictions/agencies. Contractor to coordinate with the Engineer of Record any applicable modifications to the project estimates of cost, bonding amount determinations, plan check fees for changes to approved documents, and/or any other regulatory requirements resulting from the product substitution.

1.5 HANDLING AND STORAGE

Prevent damage to materials during storage and handling.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 The device shall be a cylindrical or rectangular, all concrete structure (including risers), constructed from precast concrete riser and slab components or monolithic precast structure(s), installed to conform to ASTM C 891 and to any required state highway, municipal or local specifications; whichever is more stringent. The device shall be watertight.

2.1.2 Cartridge Deck The cylindrical concrete device shall include a fiberglass deck. The rectangular concrete device shall include a coated aluminum deck. In either instance, the insert shall be bolted and sealed watertight inside the precast concrete chamber. The deck shall serve as: (a) a horizontal divider between the lower treatment zone and the upper treated effluent zone; (b) a deck for attachment of filter cartridges such that the membrane filter elements of each cartridge extend into the lower treatment zone; (c) a platform for maintenance workers to service the filter cartridges (maximum manned weight = 450 pounds (204 kg)); (d) a conduit for conveyance of treated water to the effluent pipe.

2.1.3 Membrane Filter Cartridges Filter cartridges shall be comprised of reusable cylindrical membrane filter elements connected to a perforated head plate. The number of membrane filter elements per cartridge shall be a minimum of eleven 2.75-inch (70-mm) diameter elements. The length of each filter element shall be a minimum 15 inches (381 mm). Each cartridge shall be fitted into the cartridge deck by insertion into a cartridge receptacle that is permanently mounted into the cartridge deck. Each cartridge shall be secured by a cartridge lid that is threaded onto the receptacle, or similar mechanism to secure the cartridge into the deck. The maximum treatment flow rate of a filter cartridge shall be controlled by an orifice in the cartridge lid, or on the individual cartridge itself, and based on a design flux rate (surface loading rate) determined by the maximum treatment flow rate per unit of filtration membrane surface area. The maximum design flux rate shall be 0.21 gpm/ft² (0.142 lps/m²).

Each membrane filter cartridge shall allow for manual installation and removal. Each filter cartridge shall have filtration membrane surface area and dry installation weight as follows (if length of filter cartridge is between those listed below, the surface area and weight shall be proportionate to the next length shorter and next length longer as shown below):

Filter Cartridge Length (in / mm)	Minimum Filtration Membrane Surface Area (ft2 / m2)	Maximum Filter Cartridge Dry Weight (lbs / kg)
15	106 / 9.8	10.5 / 4.8
27	190 / 17.7	15.0 / 6.8
40	282 / 26.2	20.5 / 9.3
54	381 / 35.4	25.5 / 11.6

2.1.4 Backwashing Cartridges The filter device shall have a weir extending above the cartridge deck, or other mechanism, that encloses the high flow rate filter cartridges when placed in their respective cartridge receptacles within the cartridge deck. The weir, or other mechanism, shall collect a pool of filtered water during inflow events that backwashes the high flow rate cartridges when the inflow

event subsides. All filter cartridges and membranes shall be reusable and allow for the use of filtration membrane rinsing procedures to restore flow capacity and sediment capacity; extending cartridge service life.

2.1.5 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the deck. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

2.1.6 Bend Structure The device shall be able to be used as a bend structure with minimum angles between inlet and outlet pipes of 90-degrees or less in the stormwater conveyance system.

2.1.7 Double-Wall Containment of Hydrocarbons The cylindrical precast concrete device shall provide double-wall containment for hydrocarbon spill capture by a combined means of an inner wall of fiberglass, to a minimum depth of 12 inches (305 mm) below the cartridge deck, and the precast vessel wall.

2.1.8 Baffle The filter device shall provide a baffle that extends from the underside of the cartridge deck to a minimum length equal to the length of the membrane filter elements. The baffle shall serve to protect the membrane filter elements from contamination by floatables and coarse sediment. The baffle shall be flexible and continuous in cylindrical configurations, and shall be a straight concrete or aluminum wall in rectangular configurations.

2.1.9 Sump The device shall include a minimum 24 inches (610 mm) of sump below the bottom of the cartridges for sediment accumulation, unless otherwise specified by the design engineer. Depths less than 24 inches may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

2.2 PRECAST CONCRETE SECTIONS

All precast concrete components shall be manufactured to a minimum live load of HS-20 truck loading or greater based on local regulatory specifications, unless otherwise modified or specified by the design engineer, and shall be watertight.

2.3 JOINTS All precast concrete manhole configuration joints shall use nitrile rubber gaskets and shall meet the requirements of ASTM C443, Specification C1619, Class D or engineer approved equal to ensure oil resistance. Mastic sealants or butyl tape are not an acceptable alternative.

2.4 GASKETS Only profile neoprene or nitrile rubber gaskets in accordance to CSA A257.3-M92 will be accepted. Mastic sealants, butyl tape or Conseal CS-101 are not acceptable gasket materials.

2.5 FRAME AND COVER Frame and covers must be manufactured from cast-iron or other composite material tested to withstand H-20 or greater design loads, and as approved by the

local regulatory body. Frames and covers must be embossed with the name of the device manufacturer or the device brand name.

2.6 DOORS AND HATCHES If provided shall meet designated loading requirements or at a minimum for incidental vehicular traffic.

2.7 CONCRETE All concrete components shall be manufactured according to local specifications and shall meet the requirements of ASTM C 478.

2.8 FIBERGLASS The fiberglass portion of the filter device shall be constructed in accordance with the following standard: ASTM D-4097: Contact Molded Glass Fiber Reinforced Chemical Resistant Tanks.

2.9 STEPS Steps shall be constructed according to ASTM D4101 of copolymer polypropylene, and be driven into preformed or pre-drilled holes after the concrete has cured, installed to conform to applicable sections of state, provincial and municipal building codes, highway, municipal or local specifications for the construction of such devices.

2.10 INSPECTION All precast concrete sections shall be inspected to ensure that dimensions, appearance and quality of the product meet local municipal specifications and ASTM C 478.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter must be verified in accordance with ISO 14034:2016 Environmental management – Environmental technology verification (ETV).

3.1.2 Function - The stormwater quality filter treatment device shall function to remove pollutants by the following unit treatment processes; sedimentation, floatation, and membrane filtration.

3.1.3 Pollutants - The stormwater quality filter treatment device shall remove oil, debris, trash, coarse and fine particulates, particulate-bound pollutants, metals and nutrients from stormwater during runoff events.

3.1.4 Bypass - The stormwater quality filter treatment device shall typically utilize an external bypass to divert excessive flows. Internal bypass systems shall be equipped with a floatables baffle, and must avoid passage through the sump and/or cartridge filtration zone.

3.1.5 Treatment Flux Rate (Surface Loading Rate) – The stormwater quality filter treatment device shall treat 100% of the required water quality treatment flow based on a maximum design treatment flux rate (surface loading rate) across the membrane filter cartridges of 0.21 gpm/ft² (0.142 lps/m²).

3.2 FIELD TEST PERFORMANCE

At a minimum, the stormwater quality filter device shall have been field tested and verified with a minimum 25 TARP qualifying storm events and field monitoring shall have been conducted according to the TARP 2009 NJDEP TARP field test protocol, and have received NJCAT verification.

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median TSS removal efficiency of 85% and a minimum median SSC removal efficiency of 95%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce the turbidity from influent from a range of 5 to 171 NTU to an effluent turbidity of 15 NTU or lower.

3.2.5 Nutrient (Total Phosphorus & Total Nitrogen) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Phosphorus removal of 55%, and a minimum median Total Nitrogen removal of 50%.

3.2.6 Metals (Total Zinc & Total Copper) Removal - The stormwater quality filter treatment device shall have demonstrated a minimum median Total Zinc removal of 55%, and a minimum median Total Copper removal of 85%.

3.3 INSPECTION and MAINTENANCE

The stormwater quality filter device shall have the following features:

3.3.1 Durability of membranes are subject to good handling practices during inspection and maintenance (removal, rinsing, and reinsertion) events, and site specific conditions that may have heavier or lighter loading onto the cartridges, and pollutant variability that may impact the membrane structural integrity. Membrane maintenance and replacement shall be in accordance with manufacturer's recommendations.

3.3.2 Inspection which includes trash and floatables collection, sediment depth determination, and visible determination of backwash pool depth shall be easily conducted from grade (outside the structure).

3.3.3 Manual rinsing of the reusable filter cartridges shall promote restoration of the flow capacity and sediment capacity of the filter cartridges, extending cartridge service life.

3.3.4 The filter device shall have a minimum 12 inches (305 mm) of sediment storage depth, and a minimum of 12 inches between the top of the sediment storage and bottom of the filter cartridge tentacles, unless otherwise specified by the design engineer. Variances may have an impact on the total performance and/or longevity between cartridge maintenance/replacement of the device.

3.3.5 Sediment removal from the filter treatment device shall be able to be conducted using a standard maintenance truck and vacuum apparatus, and a minimum one point of entry to the sump that is unobstructed by filter cartridges.

3.3.6 Maintenance access shall have a minimum clear height that provides suitable vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of the receptacles and deck for the entire length of the cartridge.

3.3.7 Filter cartridges shall be able to be maintained without the requirement of additional lifting equipment.

PART 4 – EXECUTION

4.1 INSTALLATION

4.1.1 PRECAST DEVICE CONSTRUCTION SEQUENCE

The installation of a watertight precast concrete device should conform to ASTM C 891 and to any state highway, municipal or local specifications for the construction of manholes, whichever is more stringent. Selected sections of a general specification that are applicable are summarized below.

4.1.1.1 The watertight precast concrete device is installed in sections in the following sequence:

- aggregate base
- base slab
- treatment chamber and cartridge deck riser section(s)
- bypass section
- connect inlet and outlet pipes
- concrete riser section(s) and/or transition slab (if required)
- maintenance riser section(s) (if required)
- frame and access cover

4.1.2 The precast base should be placed level at the specified grade. The entire base should be in contact with the underlying compacted granular material. Subsequent sections, complete with joint seals, should be installed in accordance with the precast concrete manufacturer's recommendations.

4.1.3 Adjustment of the stormwater quality treatment device can be performed by lifting the upper sections free of the excavated area, re-leveling the base, and re-installing the sections. Damaged sections and gaskets should be repaired or replaced as necessary to restore original condition and watertight seals. Once the stormwater quality treatment device has been constructed, any/all lift holes must be plugged watertight with mortar or non-shrink grout.

4.1.4 Inlet and Outlet Pipes Inlet and outlet pipes should be securely set into the device using approved pipe seals (flexible boot connections, where applicable) so that the structure is watertight, and such that any pipe intrusion into the device does not impact the device functionality.

4.1.5 Frame and Cover Installation Adjustment units (e.g. grade rings) should be installed to set the frame and cover at the required elevation. The adjustment units should be laid in a full bed of mortar with successive units being joined using sealant recommended by the manufacturer. Frames for the cover should be set in a full bed of mortar at the elevation specified.

4.2 MAINTENANCE ACCESS WALL
In some instances the Maintenance Access Wall, if provided, shall require an extension attachment and sealing to the precast wall and cartridge deck at the job site, rather than at the precast facility. In this instance, installation of these components shall be performed according to instructions provided by the manufacturer.

4.3 FILTER CARTRIDGE INSTALLATION Filter cartridges shall be installed in the cartridge deck only after the construction site is fully stabilized and in accordance with the manufacturer's guidelines and recommendations. Contractor to contact the manufacturer to schedule cartridge delivery and review procedures/requirements to be completed to the device prior to installation of the cartridges and activation of the system.

PART 5 – QUALITY ASSURANCE

5.1 FILTER CARTRIDGE INSTALLATION Manufacturer shall coordinate delivery of filter cartridges and other internal components with contractor. Filter cartridges shall be delivered and installed complete after site is stabilized and unit is ready to accept cartridges. Unit is ready to accept cartridges after is has been cleaned out and any standing water, debris, and other materials have been removed. Contractor shall take appropriate action to protect the filter cartridge receptacles and filter cartridges from damage during construction, and in accordance with the manufacturer's recommendations and guidance. For systems with cartridges installed prior to full site stabilization and prior to system activation, the contractor can plug inlet and outlet pipes to prevent stormwater and other influent from entering the device. Plugs must be removed during the activation process.

5.2 INSPECTION AND MAINTENANCE

5.2.1 The manufacturer shall provide an Owner's Manual upon request.

5.2.2 After construction and installation, and during operation, the device shall be inspected and cleaned as necessary based on the manufacturer's recommended inspection and maintenance guidelines and the local regulatory agency/body.

5.3 REPLACEMENT FILTER CARTRIDGES When replacement membrane filter elements and/or other parts are required, only membrane filter elements and parts approved by the manufacturer for use with the stormwater quality filter device shall be installed.

END OF SECTION

STANDARD PERFORMANCE SPECIFICATION
STORMWATER QUALITY – MEMBRANE FILTRATION TREATMENT DEVICE

PART 1 – GENERAL

1.1 WORK INCLUDED

This section specifies requirements for selecting, sizing, and designing an underground stormwater quality membrane filtration treatment device that removes pollutants from stormwater runoff through the unit operations of sedimentation, floatation, and membrane filtration.

1.2 REFERENCE STANDARDS & PROCEDURES

ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV)

1.3 SUBMITTALS

1.3.1 All submittals, including sizing reports & shop drawings, shall be submitted upon request with each order to the contractor then forwarded to the Engineer of Record for review and acceptance. Shop drawings shall detail all OGS components, elevations, and sequence of construction.

1.3.2 Alternative devices shall have features identical to or greater than the specified device, including: filtration surface area, treatment chamber diameter, treatment chamber wet volume, sediment storage volume, and oil storage volume.

1.3.3 Unless directed otherwise by the Engineer of Record, filtration treatment device product substitutions or alternatives submitted within ten days prior to project bid shall not be accepted. All alternatives or substitutions submitted shall be signed and sealed by a local registered Professional Engineer, based on the exact same criteria detailed in Section 3, in entirety, subject to review and approval by the Engineer of Record.

PART 2 – PRODUCTS

2.1 GENERAL

2.1.1 Maintenance Access to Captured Pollutants The filter device shall contain an opening(s) that provides maintenance access for removal of accumulated floatable pollutants and sediment, removal of and replacement of filter cartridges, cleaning of the sump, and rinsing of the internal components. Access shall have a minimum clear vertical clear space over all of the filter cartridges. Filter cartridges shall be able to be lifted straight vertically out of their installed placement for the entire length of the cartridge.

2.1.2 Pollutant Storage: The Filter device shall include a sump for sediment storage, and a protected volume for the capture and storage of petroleum hydrocarbons and buoyant gross pollutants.

PART 3 – PERFORMANCE

3.1 GENERAL

3.1.1 Verification – The stormwater quality filter treatment device shall have been field tested in accordance with either TARP Tier II Protocol (TARP, 2003) and New Jersey Tier II Stormwater Test Requirements – Amendments to TARP Tier II Protocol (NJDEP, 2009) or Washington State Technology Assessment Protocol – Ecology (TAPE), 2011 or later version. The field test shall have been verified in accordance with ISO 14034:2016 Environmental Management – Environmental Technology Verification (ETV). See Section 3.2 of this specification for field test performance requirements.

3.2 FIELD TEST PERFORMANCE

The field test (as specified in section 3.1.1)shall have monitored a minimum of twenty (20) TARP or TAPE qualifying storm events, and report at **minimum** the following results:

3.2.1 Suspended Solids Removal - The stormwater quality filter treatment device shall have ISO 14034 ETV verified load based median TSS removal efficiency of at least 85% and load based median SSC removal efficiency of at least 98%.

3.2.2 Runoff Volume – The stormwater quality filter treatment device shall be engineered, designed, and sized to treat a minimum of 90 percent of the annual runoff volume determined from use of a minimum 15-year rainfall data set.

3.2.3 Fine Particle Removal - The stormwater quality filter treatment device shall have demonstrated the ability to capture fine particles as indicated by a minimum median removal efficiency of 75% for the particle fraction less than 25 microns, and an effluent d_{50} of 15 microns or lower for all monitored storm events.

3.2.4 Turbidity Reduction - The stormwater quality filter treatment device shall have demonstrated the ability to reduce turbidity such that effluent turbidity is 15 NTU or lower.

3.2.5 Nutrients & Metals – The stormwater quality filter treatment device shall have ISO 14034 ETV Verified minimum load based removal efficiencies for the following:

3.2.5.1 Total Phosphorus (TP) Removal - Median TP removal efficiency of at least 49%.

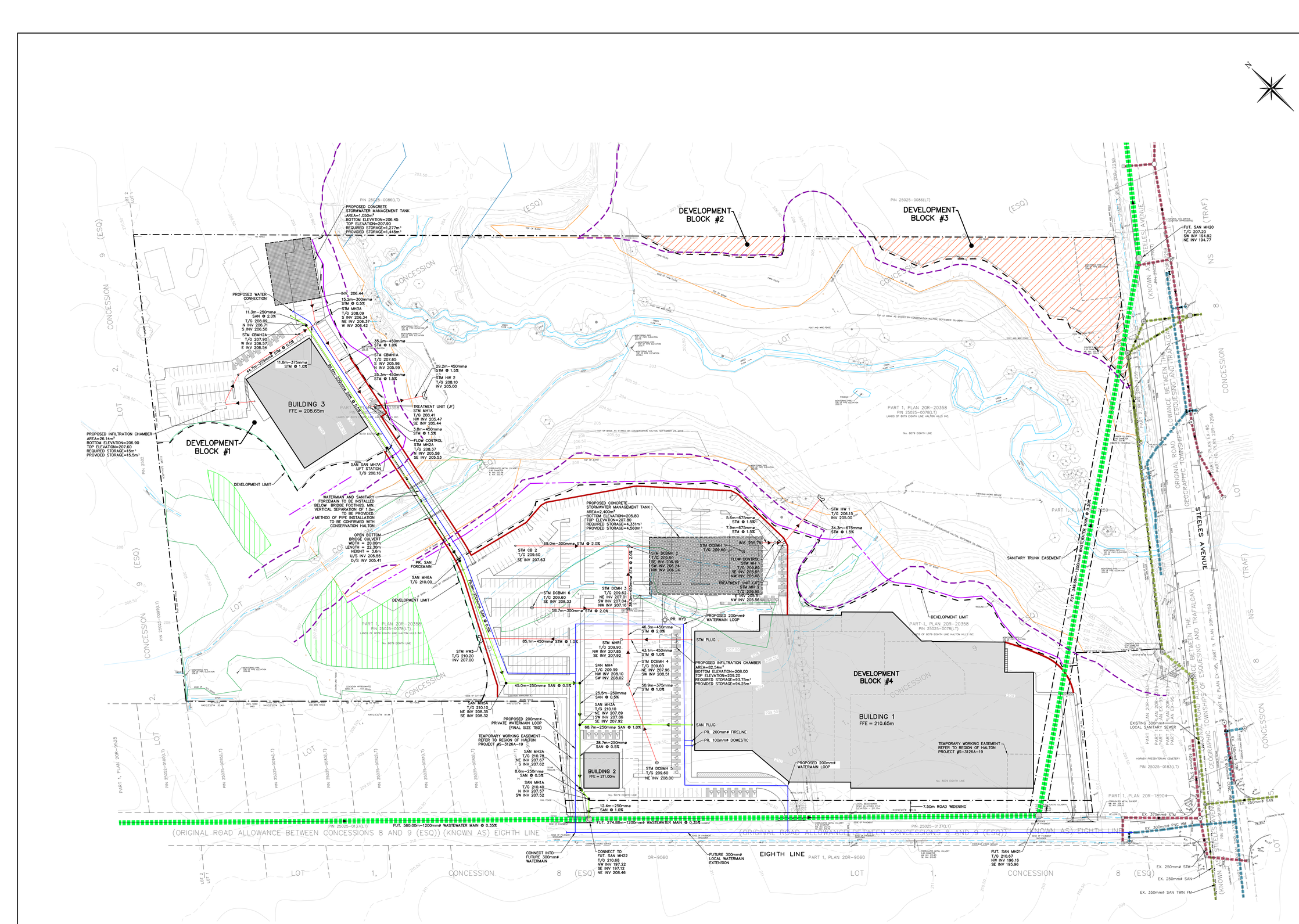
3.2.5.2 Total Nitrogen (TN) Removal - Median TN removal efficiency of at least 39%.

3.2.5.3 Total Zinc (Zn) Removal - Median Zn removal efficiency of at least 69%.

3.2.5.4 Total Copper (Cu) Removal - Median Cu removal efficiency of at least 91%.

END OF SECTION

DRAWINGS & FIGURES



LEGEND

- PROPERTY LINE
- EXISTING WATERMAIN & GATE VALVE
- EXISTING STORM SEWER & MANHOLE
- EXISTING SINGLE / DOUBLE CATCHBASIN
- PR. SINGLE / DOUBLE CATCHBASIN
- PR. SINGLE / DOUBLE CATCHBASIN MANHOLE
- EXISTING FIRE HYDRANT
- PROPOSED FIRE HYDRANT
- EXISTING SANITARY SEWER & MANHOLE
- FUTURE TRUNK SEWER & MANHOLE
- EXISTING SANITARY SEWER & MANHOLE
- PROPOSED WATERMAIN
- PROPOSED SANITARY SEWER & MANHOLE
- PROPOSED STORM SEWER & MANHOLE
- DEVELOPMENT LIMIT
- PROPOSED RETAINING WALL
- REGIONAL FLOODPLAIN + 15m
- WETLAND COMPENSATION AREA + 30m
- LONG TERM STABLE TOP OF SLOP + 15m
- STACKED WETLAND (CONSERVATION HALTON OCTOBER 10, 2019)
- STACKED TOP OF BANK (CONSERVATION HALTON SEPTEMBER 29, 2015)
- WETLAND MITIGATION AREA

NOT FOR CONSTRUCTION

No.	ISSUE / REVISION	YYYY/MM/DD
0	ISSUED FOR FIRST SUBMISSION (OPA)	2022/MAR/15

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FOR REVIEW

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ELEVATION NOTE:

ELEVATIONS SHOWN HERON ARE GEODETIC AND ARE DERIVED FROM GPS OBSERVATIONS ON PERMANENT GPS REFERENCE STATIONS . DATUM IS KNOWN AS CANADIAN GEODETIC VERTICAL DATUM 1928 (CGVD28), HYDROIZED AS HEIGHT–TRANSFER SYSTEM 2001–(ALSO KNOWN AS HT2 OR HT2001)

SITE BENCHMARK:

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON CONCEPT PLAN BY CORBETT LAND STRATEGIES INC. DRAWING No: (2021/JAN/24)
PROJECT No.:

DRAWING NOTES:

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ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project: STEELES AVENUE & EIGHTH LINE WATERPARK DEVELOPMENT TOWN OF HALTON HILLS

Drawing: PRELIMINARY SERVICING PLAN

CROZIER CONSULTING ENGINEERS
2800 High Point Drive
Suite 100
Milton, ON L9T 6P4
905-875-0026 T
905-875-4915 F
www.cfcrozier.ca

Drawn	V.M.	Design	S.C./A.D.F.	Project No.	1805–5424
Check	S.C./A.D.F.	Check	H.S./N.M.	Scale	1:750
				Dwg.	C102

LEGEND

- PROPERTY LINE
- EXISTING CONTOUR (0.5m)
- EXISTING CONTOUR (1.0m)
- x215.00 EXISTING GRADE
- x215.00 PROPOSED GRADE
- x215.00 PROPOSED GRADE (TO MATCH EXISTING)
- 2.0% PROPOSED MINOR FLOW DIRECTION
- DEVELOPMENT LIMIT
- PROPOSED RETAINING WALL
- REGIONAL FLOODPLAIN + 15m
- WETLAND COMPENSATION AREA + 30m
- LONG TERM STABLE TOP OF SLOP + 15m
- STACKED WETLAND (CONSERVATION HALTON OCTOBER 10, 2019)
- STACKED TOP OF BANK (CONSERVATION HALTON SEPTEMBER 29, 2015)
- EXISTING OVERLAND FLOW DIRECTION
- PROPOSED MAJOR OVERLAND FLOW DIRECTION
- WETLAND MITIGATION AREA

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0	ISSUED FOR FIRST SUBMISSION (OPA)	2022/MAR/15

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SITE BENCHMARK:

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Project
STEELES AVENUE & EIGHTH LINE
WATERPARK DEVELOPMENT
TOWN OF HALTON HILLS

Drawing
PRELIMINARY GRADING PLAN

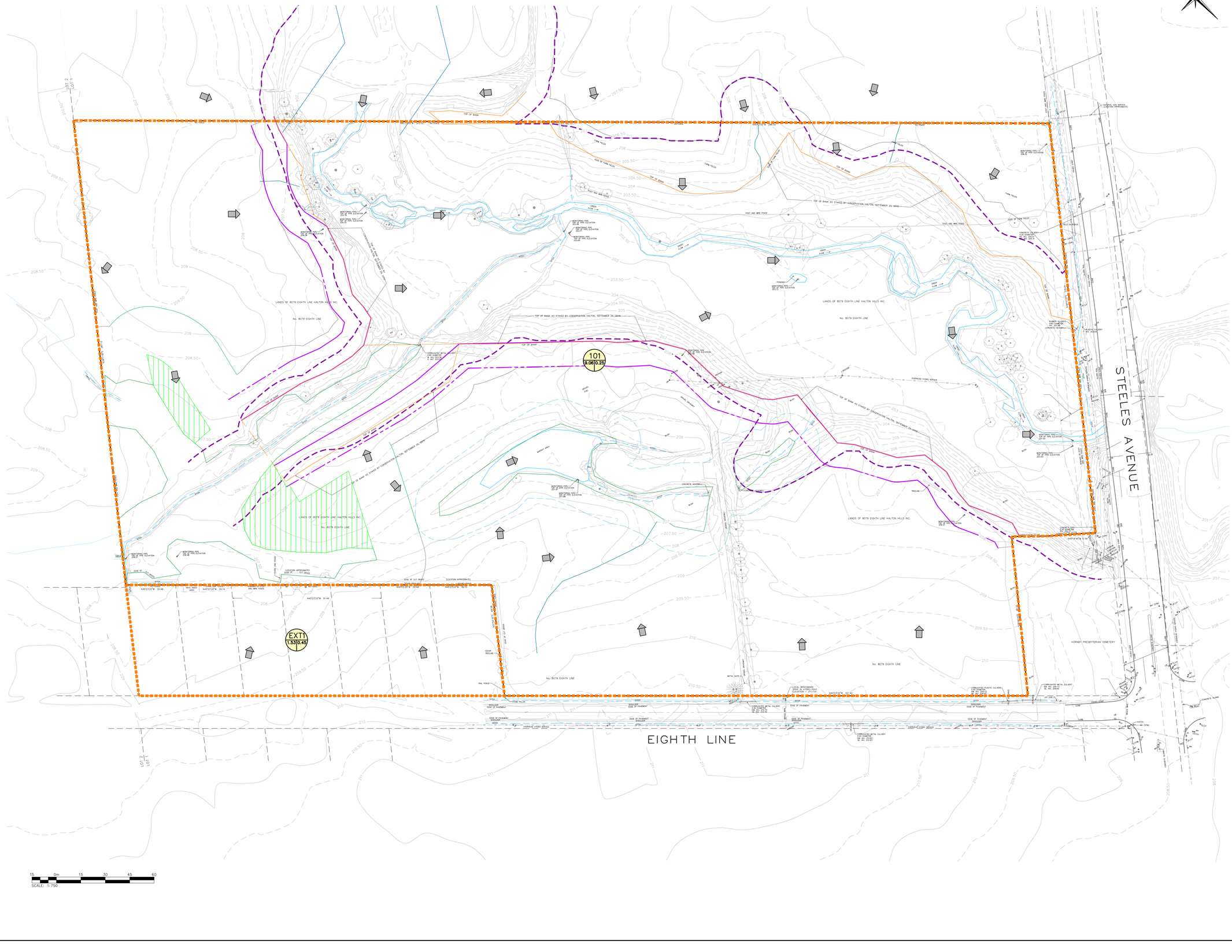
CROZIER CONSULTING ENGINEERS
2800 High Point Drive
Suite 100
Milton, ON L9T 6P4
905-875-0026 T
905-875-4915 F
www.cfcrozier.ca

Drawn	V.M.	Design	S.C./A.D.F.	Project No.	1805-5424
Check	S.C./A.D.F.	Check	H.S./N.M.	Scale	1:750
				DWG.	C103

SCALE: 1:750

LEGEND

- PROPERTY LINE
- EXISTING CONTOUR (0.5m)
- EXISTING CONTOUR (1.0m)
- EXISTING DITCH
- EXISTING OVERLAND FLOW DIRECTION
- STORM DRAINAGE CATCHMENT
- CATCHMENT I.D.
- AREA (ha) | RUNOFF COEFFICIENT
- REGIONAL FLOODPLAIN + 15m
- WETLAND COMPENSATION AREA + 30m
- LONG TERM STABLE TOP OF SLOP + 15m
- STACKED WETLAND (CONSERVATION HALTON OCTOBER 10, 2019)
- STACKED TOP OF BANK (CONSERVATION HALTON SEPTEMBER 29, 2015)
- WETLAND MITIGATION AREA



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SITE BENCHMARK:

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON CONCEPT PLAN BY CORBETT LAND STRATEGIES INC.
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PROJECT No.:

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Project

STEELES AVENUE & EIGHTH LINE WATERPARK DEVELOPMENT TOWN OF HALTON HILLS

Drawing

PRE-DEVELOPMENT DRAINAGE PLAN

CROZIER CONSULTING ENGINEERS
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905-875-0026 T
905-875-4915 F
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Drawn	V.M.	Design	S.C./A.D.F.	Project No.	1805-5424
Check	S.C./A.D.F.	Check	H.S./N.M.	Scale	1:750
				Fig.	FIG-1

LEGEND

- PROPERTY LINE
- EXISTING CONTOUR (0.5m)
- EXISTING CONTOUR (1.0m)
- EXISTING DITCH
- EXISTING OVERLAND FLOW DIRECTION
- PROPOSED MAJOR OVERLAND FLOW DIRECTION
- EXISTING STORM DRAINAGE CATCHMENT
- PROPOSED STORM DRAINAGE CATCHMENT
- CATCHMENT I.D.
- AREA (ha) | RUNOFF COEFFICIENT
- DEVELOPMENT LIMIT
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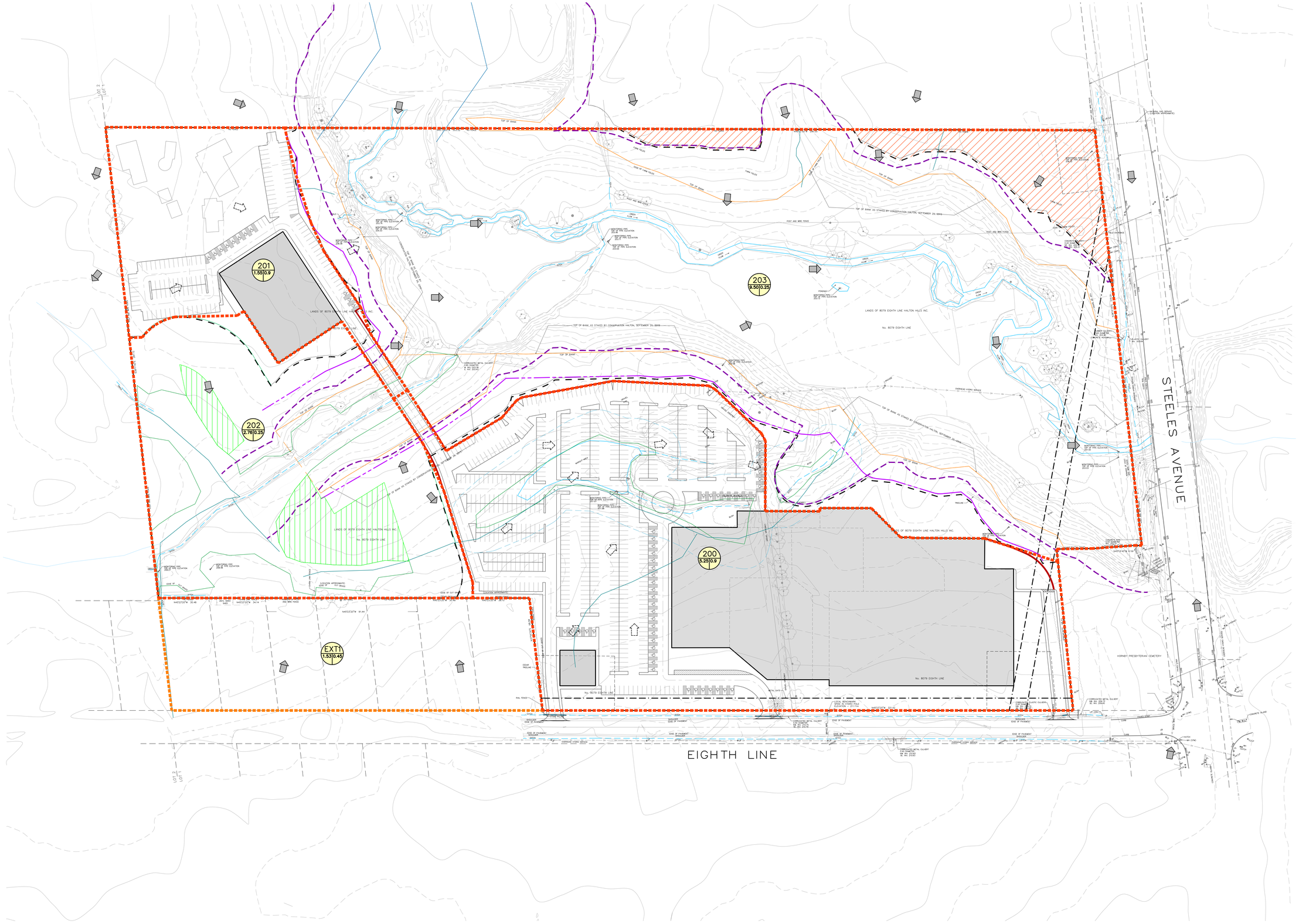
- LONG TERM STABLE TOP OF SLOP + 15m
- STACKED WETLAND (CONSERVATION HALTON OCTOBER 10, 2019)
- STACKED TOP OF BANK (CONSERVATION HALTON SEPTEMBER 29, 2015)
- WETLAND MITIGATION AREA



NOT FOR CONSTRUCTION

No.	ISSUE / REVISION	YYYY/MMM/DD
0	ISSUED FOR FIRST SUBMISSION (OPA)	2022/MAR/15

Stamp

FOR REVIEW

BEARING NOTE:

BEARINGS SHOWN HEREON ARE GRID BEARINGS AND ARE DERIVED FROM NETWORK REAL TIME GPS OBSERVATIONS AND REFERRED TO THE UTM PROJECTION ZONE 17, NAD83 (CSRS 2010)

ELEVATION NOTE:

ELEVATIONS SHOWN HEREON ARE GEODETIC AND ARE DERIVED FROM GPS OBSERVATIONS ON PERMANENT GPS REFERENCE STATIONS. DATUM IS KNOWN AS CANADIAN GEODETIC VERTICAL DATUM 1928 (CGVD28), HYBRIDIZED AS HEIGHT-TRANSFER SYSTEM 2001-(ALSO KNOWN AS HT2 OR HT2001)

SITE BENCHMARK:

SITE PLAN NOTES:

DESIGN ELEMENTS ARE BASED ON CONCEPT PLAN BY CORBETT LAND STRATEGIES INC. DRAWING No: (2021/JAN/24)
PROJECT No.:

DRAWING NOTES:

THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS, LEVELS, AND DATUMS ON SITE AND REPORT ANY DISCREPANCIES OR OMISSIONS TO THIS OFFICE PRIOR TO CONSTRUCTION.

THIS DRAWING IS TO BE READ AND UNDERSTOOD IN CONJUNCTION WITH ALL OTHER PLANS AND DOCUMENTS APPLICABLE TO THIS PROJECT. DO NOT SCALE THIS DRAWING.

ALL EXISTING UNDERGROUND UTILITIES TO BE VERIFIED IN THE FIELD BY THE CONTRACTOR PRIOR TO CONSTRUCTION.

Project

STEELES AVENUE & EIGHTH LINE WATERPARK DEVELOPMENT TOWN OF HALTON HILLS

Drawing

POST-DEVELOPMENT DRAINAGE PLAN

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Drawn	V.M.	Design	S.C./A.D.F.	Project No.	1805-5424
Check	S.C./A.D.F.	Check	H.S./N.M.	Scale	1:750

Fig. FIG-2